Situating mHealth in the Workplace:

A Coordination Studies Perspective

Final

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Declaration

I, Brendon Bernhard Wolff-Piggott

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DEFINITIONS

Appropriation	The adoption and adaptation of technologies as people make them part of their everyday work practices (Dourish, 2003)
Coordination	The process of interaction that integrates a collective set of interdependent tasks (adapted from Okhuysen & Bechky, 2009)
Health Intermediaries	Health care practitioners who provide health information in marginalised contexts (van Zyl & de la Harpe, 2014)
Health Professionals	Doctors and nurses (see definition of Clinic Staff ranks overleaf)
mHealth	The use of mobile computing and communication technologies in health care and public health (Fiordelli, Diviani, & Schulz, 2013)
NGO	Non-governmental organisation
Support Staff	Used in this research to describe clinic staff not providing health care services e.g. administrative staff, general workers (cleaners etc)

ABBREVIATIONS

ART	Antiretroviral Therapy (for the suppression of HIV virus)
eHealth	Electronic Health (including mHealth in its scope)
EPWP	Expanded Public Works Programme (abbreviation commonly used to describe workers employed under the programme)
HIT	Health Information Technology
ICT	Information and Communication Technology
ICTD	Information and Communication Technology for Development
IS	Information Systems
mHealth	Mobile health
NDoH	National Department of Health (of South Africa)
PHC	Primary Health Care

DEFINITION OF CLINIC STAFF RANKS AS USED IN SOUTH AFRICA

Doctors	Medical professionals who have obtained the degree of MBCHB, and are registered with the South African Medical and Dental Council as practitioners. See https://www.hpcsa.co.za/. Equivalent to the North American designation of physician.
Health Workers	Doctors, nurses, health promoters, community health workers, midwives, volunteers and all other staff in the sector involved in giving direct health care services
Nurses	Registered nurses or nursing sisters (typical nursing responsibilities and registered with the South African Nursing Council) and enrolled nurses (in training to become registered nurses). See https://educonnect.co.za/nursing-in-south-africa/

ABSTRACT

A central assumption of extant mHealth literature is that the technology empowers health care staff and leads to increased efficiency in service delivery. This assumption foregrounds the transformative potential of mHealth and the active appropriation of the technology, but obscures how it integrates with existing workplace arrangements. To interrogate the limitations of this dominant assumption, this research examines how mHealth is coordinated in the workplace in practice, and the perceptions and experiences of health care staff of the place mHealth takes in their daily concerns. In this way the research reveals how existing workplace arrangements influence the way that mHealth operates in practice, and builds on extant research to clarify how this can shift responsibility for the success of the implementation onto those staff with the least recognition and security.

An interpretive case study explores the coordination of mHealth in the workplace, and analyses unexpected outcomes to identify their implications for theory and practice. In order to highlight this phenomenon the research focussed on the experiences of the clinic staff who were responsible for mHealth implementation, but were not the end users and who did not receive direct benefits themselves. The analysis drew on coordination studies to identify social and artefact-based coordination mechanisms, as well as the significance of relationships in mHealth in the workplace, yielding robust evidence that social coordination mechanisms rather than the fitness for purpose of the specific technology shaped the coordination process. Issues arising from the specific setting also influenced coordination in important ways that were not predicted in the official training material.

The research makes three theoretical contributions that advance understanding of mHealth in the workplace through abduction. First, it identifies two novel coordination mechanisms: role flexibility and covert routines. Second, through the novel concept of multiple accountability, it challenges one of the key integrative principles proposed in the coordination studies perspective, problematising it and proposing that relationships between health intermediaries and local communities are far more influential for the coordination of mHealth than extant theory has so far proposed. Third, it carries important implications for future mHealth (and, more broadly, technology coordination) scholarship, providing evidence that existing coordination mechanisms and relationships may be as influential as the transformative potential of the technology itself. The research also contributes to practice by enhancing understanding of how health intermediaries may be empowered to effectively employ mHealth in the workplace.

In a context of policy and funding uncertainty, this research contributes to an emerging literature identifying the practical mHealth issues primary health care staff face in a resource-poor environment, interrogating approaches that fail to recognise these realities.

Keywords: mHealth; coordination; coordination mechanisms; integrative perspective; health intermediaries

Extract from the Freedom Charter, as adopted by the African National Congress (ANC) of South Africa at Kliptown, 26 June 1955

"There Shall be Houses, Security and Comfort!

... A preventive health scheme shall be run by the state;

Free medical care and hospitalisation shall be provided for all, with

special care for mothers and young children ..."

mHealth Strategy Document 2015-2019 by the National Department of Health:

Foreword by the Minister, Dr PA Motsoaledi

"The successful implementation of the NDOH (National Department of Health) flagship mHealth initiative, MomConnect, saw a tremendous response of pregnant mothers being registered via a mobile platform and receiving an SMS that provides appropriate information and advice throughout their stages of pregnancy...

The South African health system can leapfrog (health system challenges) by using new technology ... through the implementation of its flagship project of implementing National Health Insurance to achieve universal health coverage as required by the National Development Plan."

"NHI White Paper doesn't explain how it will get buy-in from private doctors"

Article in The Daily Maverick, 29 January 2018

"The launch of the much-delayed National Health Insurance (NHI) White Paper – the most radical health reform in South Africa's history – was rather shambolic ... The video link between Pretoria and Cape Town had technical problems. The Director-General of Health was out of the country. Yet Health Minister, Dr Aaron Motsoaledi, soldiered valiantly on, presenting a plan that aims for all South Africans to be treated according to their health needs, and not their bank balances."

Chapter 1 INTRODUCTION

Mobile health (mHealth) is defined as the use of mobile computing and communication technologies in health care and public health (Fiordelli et al., 2013).

Currently there is great interest in the potential of mHealth to strengthen health systems in developing countries and improve services to people who have limited access. This is reflected in both the research (Chib, 2013; Sørensen, Rivett, & Fortuin, 2008; Varshney, 2014) and practitioner literatures (Haas, 2016; Vital Wave Consulting, 2009; World Health Organization and International Telecommunication Union, 2012). mHealth in developing countries is often implemented with the aim of empowering health intermediaries (Braun, Catalani, Wimbush, & Israelski, 2013; Mukherjee, 2015), or health practitioners with limited training, who act as providers of information in marginalised settings (van Zyl & de la Harpe, 2014). mHealth is intended to assist health intermediaries to work more effectively with health professionals such as doctors (physicians, in North American terminology) and nurses (Chib, Lwin, Ang, Lin, & Santoso, 2008; de la Harpe, Lotriet, Pottas, & Korpela, 2013; Mukherjee, 2015), and improve the overall efficiency of health services in this way (Global Observatory for eHealth, 2016; World Health Organization and International Telecommunication Union, 2012)

mHealth is also of significant interest to private firms, as part of an ever-growing range of electronic health services being developed (Bloom, Berdou, Standing, Guo, & Labrique, 2017). The value of the mobile technology and services industry is projected to be $44.6 trillion in 2022 (GSMA Intelligence, 2018). The routine use of mHealth in the workplace thus offers potential as an intervention to improve human health, as well as comprising a substantial industry in its own right. This introduction contextualises both of these aspects in relation to this study.

1.1 mHealth in the Workplace

Extensive empirical descriptions of mHealth projects have been provided for more than a decade by mHealth research (Adeagbo et al., 2019; Chandhanayingyong, Tangtrakulwanich, & Kiriratnikom, 2007; Chib, van Velthoven, & Car, 2015; Purkayastha, Manda, & Sanner, 2013), and have thus focused primarily on the capabilities of the technology rather than the experiences of the health care staff. A number touch on the use of mHealth by health intermediaries, although this often takes place outside of a formal workplace (Chib et al., 2008; de la Harpe et al., 2013; Huang, Blaschke, & Lucas, 2017). In many cases, the intent of these projects was to equip health intermediaries to work more effectively with nurses and other health professionals as part of the broader health system.

The health intermediaries were not the focus of the studies cited above. Nevertheless, in several studies (Chib et al., 2008; Chib, Cheong, et al., 2012; Mukherjee, 2015), their responses identified conflict with health professionals over the changed scope of their work as a source of frustration in using mHealth. One example is Chib et al.'s (2008) description of midwives encountering resentment when using their newly acquired mobile phones to call up doctors for advice. Another is Mukherjee's (2015) account, including health intermediaries expressing distress that their community outreach activities were reduced to counts of people registered, rather than cases for discussion.

A second stream of more recent research (Asangansi, 2016; Ling, Poorisat, & Chib, 2018) has begun to examine how mHealth is coordinated in workplaces such as hospitals and clinics in some detail. This work suggests that using mHealth in the workplace may lead to shifts in the relationships between health care professionals as they develop new, informal ways of interacting. Thus, Kumar et al. (2015) describe clinic nurses who were trained to photograph the results from a rapid diagnostic test (RDT) that was automatically processed and uploaded to the central server at a regional hospital. Sometimes the nurses made an incorrect diagnosis from the RDT; the matrons to whom they formally reported encouraged them to approach the laboratory technicians at the hospital to resolve these misdiagnoses. But as a result, the nurses started to become accountable to the technicians at the remote site rather than to their clinic matrons (*ibid.*).

A third, emerging stream of research examines how health professionals and health intermediaries draw on personal resources such as their own money and time to use their cell phones to assist patients – sometimes in the complete absence of formal mHealth in their workplaces (Anstey Watkins, Goudge, Gómez-Olivé, & Griffiths, 2018; Hampshire et al., 2016). The work of Hampshire et al. (2016) emphasises how this use of personal resources to provide improved care is often taken on by low status health intermediaries under conditions of minimal financial reward and security, raising concerns of reinforcing socio-economic inequality.

This highlights the relatively unexplored issue of the unintended consequences of mobile technology for vulnerable populations; a topic which has received some attention in the study of international migrant workers (for example, Chib, Wilkin and Hua (2013)) and in "blue-collar" work such as janitorial services (Stephens, 2018). Bentley, Chib, and Poveda (2019) argue more broadly from the example of openness in information systems that innovations can be assigned a normative value in research, at the expense of understanding the implications in practice for power relationships in

society. The research in this thesis builds on this prior scholarship in analysing mHealth in relation to the role of health intermediaries.

The issue raised by the second research stream, that of the relationships between health care staff and their influence on how information technology has been used in the workplace, has been explored in some detail in the domain of Information Systems (IS) (Hanseth, Thoresen, & Winner, 1994; Kane & Labianca, 2011; Munkvold, Ellingsen, & Koksvik, 2006; Romanow, Cho, & Straub, 2012; Romanow, Rai, & Keil, 2018), and in the related field of health communication (Barrett & Stephens, 2016). It is well established that the strongly-defined role of medical professionals influence their attitudes towards and use of Health Information Technology (HIT) in the workplace (Kane & Labianca, 2011; Romanow et al., 2012). As a consequence the coordination of HIT use is known to involve delegation from higher- to lower-status staff (e.g. from doctors to nurses) (Kane & Labianca, 2011) and to be often more strongly influenced by peer perceptions rather than management directives (Barrett & Stephens, 2016).

It is, however, unclear to what extent the dynamics identified in HIT studies are relevant to mHealth. HIT research is primarily concerned with the study of desktop- and enterprise-based software (Furukawa et al., 2014) rather than mobile systems, and has not addressed the role of health intermediaries in detail (Bossen & Foss, 2016). However, this research argues that the frequency with which coordination between health care staff is cited as an important influence in HIT (Pine & Mazmanian, 2017; Romanow et al., 2018; Sanner & Øvrelid, 2019) indicates that it also merits consideration in research on mHealth.

It is generally agreed that it is essential to coordinate mHealth with everyday work practices (Källander et al., 2013; Labrique et al., 2018; Leon, Schneider, & Daviaud, 2012; Ling et al., 2018) in established workplaces in order for it to be successful, and there is consequently a need to examine the processes and impacts of this coordination. Coordination also provides a powerful lens through which to examine the relationships between healthcare staff and how they employ shared understandings and technologies (Faraj & Xiao, 2006). This is discussed in more detail below.

1.2 **Coordination in the Health Care Workplace**

Research has robustly established that doctors and nurses need to continually coordinate their work to deliver effective health care (Lindberg, Erik, & Walter, 2019; A. Strauss, Fagerhaugh, Suczek, & Wiener, 1985), by ensuring that each member of staff knows what they need to do and that any necessary changes are implemented speedily. Coordination in the healthcare workplace relies heavily on well-defined staff roles and formally agreed plans of action to cope with task

interdependence and uncertainty (Faraj & Xiao, 2006; Romanow et al., 2018). Doctors, and medical specialists in particular, exercise authority over nurses (Currie, Lockett, Finn, Martin, & Waring, 2012; Salhani & Coulter, 2009) and non-professional support staff (Bossen & Foss, 2016). To address these issues, coordination in health care workplaces has received significant research attention (Bodolica & Spraggon, 2014; Ferlie, Fitzgerald, Wood, & Hawkins, 2005; Gittell, Godfrey, & Thistlethwaite, 2013).

The study of coordination between clinical staff and those who support them is less well-developed (Bossen & Foss, 2016), but also identifies a hierarchy between more and less qualified health workers. In all these situations, the delivery of health care involves interdependent roles and requires effective coordination. However, the optimal way to encourage effective coordination remains a topic of debate (Bodolica & Spraggon, 2014; Pullon, Morgan, Macdonald, McKinlay, & Gray, 2016).

For more than a quarter of a century, coordination mechanisms in formal health care settings such as hospital wards have been documented and studied (Bossen & Markussen, 2010; Pine & Mazmanian, 2017; A. Strauss et al., 1985). Formal coordination mechanisms include social processes such as ward rounds (A. Strauss et al., 1985) and shift handover meetings (Munkvold et al., 2006). These are augmented by informal arrangements to handle unexpected or time-critical decisions where formal coordination mechanisms cannot be used (Faraj & Xiao, 2006). These social arrangements are further complemented by the use of shared objects and artefacts such as standardised protocols for medical procedures (Timmermans & Berg, 1997) and treatment plans (Bossen & Markussen, 2010). An information system may also be an artefact in a similar way (Berg & Bowker, 1997).

Professionals such as doctors and nurses are part of well-developed institutions that provide them with clear roles in health organisations. Although health systems in developing countries are often relatively weak (Williams & Boren, 2008), doctors and nurses there nevertheless identify strongly with their professions (Sunguya, Hinthong, Jimba, & Yasuoka, 2014). Health intermediaries, by contrast, are only loosely integrated into the wider health system (Perry & Crigler, 2014). Unlike healthcare professionals, they have limited recognition or opportunity for progression in the workplace (Kane et al., 2016; Maes, Closser, Tesfaye, & Abesha, 2019). But although some studies (Chib et al., 2008; Kumar et al., 2015) have identified mHealth as opening up the possibility of expanding their role and enhancing their prestige, this limiting context suggests that routine mHealth use could equally risk reinforcing the intermediaries' subordinate status. The coordination

of mHealth with other workplace practices is thus likely to be strongly influenced by the perceived opportunities for, and threats to, different occupational groups presented by its implementation.

1.3 **Purpose of the Research**

Given the important debates around contextual issues described above, this research contributes to current scholarship on how the introduction of mHealth may change practices in the workplace as the technology becomes more established (Asangansi, 2016; Ling et al., 2018). In particular, it provides evidence of how the claims of the "techno-optimists" (in the words of Chib, 2013) of straightforward adoption and the concerns of the medical community regarding effective health outcomes (Beratarrechea et al., 2014; Lee et al., 2016; Tomlinson, Rotheram-Borus, Swartz, & Tsai, 2013) are likely to be resolved, by expanding understanding of the coordination of mHealth by different levels of staff.

The overall research question addressed is thus: "How is mHealth coordinated with existing workplace arrangements"? Concepts from a coordination studies perspective (see Table 4) are employed to analyse how integration with existing work practices takes place.

1.4 **Research Approach**

Coordination of mHealth in the workplace is explored via a case study approach (Flyvbjerg, 2006; Yin, 2002). The case study investigation was carried out at three primary health care (PHC) clinics using the national MomConnect maternal messaging service in South Africa (Barron et al., 2018) (*for detail, see section 5.2.1*). The service is designed with the primary goal of providing free information to pregnant women that is tailored to their stage of pregnancy. Clinic staff are, however, required to register women, to ensure that they receive a full check-up and do not use the service as a substitute to avoid clinic visits. The training literature suggests several registration routines (RMCH, 2014) where either the nurse or a health intermediary can perform the registration (see Table 14), in line with existing workplace arrangements. The process is shown schematically in Figure 6.

MomConnect registration in clinics presents a promising opportunity to study the coordination of mHealth by frontline staff. It is selected because it can yield insights transferable to other cases of large-scale, routine mHealth implementation: it is a national initiative within an established health system. Further, since information systems are not extensively used in South African public sector primary healthcare clinics, the MomConnect initiative has the capacity to yield insights on the characteristics of mHealth use that are influenced by delivery via mobile handset, providing some basis for comparison and contrast with mainstream HIT research.

Because Haas (2016) has suggested that interoperability between mHealth and other health sector information systems is important for their effectiveness and scaling, the research further draws deliberately on insights from related fields, such as HIT, to complement the mHealth literature.

The research employs an interpretive approach, drawing on interviews, observation sessions and documentation to understand the experiences of staff in their coordination of mHealth with established workplace practices. It draws on the principles of Klein and Myers (1999), and is also informed by more recent developments regarding the stance taken by the researcher (Charmaz, 2014; Krauss, 2013). This research takes the position that all investigations are necessarily influenced by the nature of the setting under study, and the position of the researcher in relation to this setting (Charmaz, 2014; Timmermans & Tavory, 2012).

The first phase of the analysis was carried out inductively to identify themes emerging from the data. This initial analysis was followed by a deductive coding, based on the coordination studies perspective developed in the course of the literature review. These analyses was followed by an abductive phase (Sarker, Xiao, Beaulieu, & Lee, 2018) to explore themes emerging from the data that were not aligned with existing theory. The data was analysed via an iterative process to organise the initial set of themes, and then to derive higher-level concepts from a re-examination of the data in the light of relevant literature and theory (Timmermans & Tavory, 2012).

1.5 **Assumptions and Definitions**

A central assumption made in this research is that the coordination of mHealth in the workplace is a sociotechnical phenomenon, in line with a foundational research stream in IS (Sarker, Chatterjee, Xiao, & Elbanna, 2019). In other words, it is not simply the unfolding of the steps envisaged by the designers of the system but rather a social process influenced by established work practices and familiarity with a range of other artefacts that include (but are not limited to) information systems (Dourish, 2004b; Riemer & Johnston, 2014). This implies that coordination is not merely a process that takes place at the level of the individual and their relationship to a technology, but also in terms of broader occupational and organisational relationships.

Another assumption is that health professionals and intermediaries can influence how mHealth is used. In other words, that they are active agents who can make substantive choices in how they choose to make use of the technology (Boudreau & Robey, 2005; Leonardi & Barley, 2010).

A list of definitions of key terms is provided on page vi, and a list of abbreviations is provided on page vii.

1.6 **Thesis Layout**

The thesis is structured as follows:

- Chapter 1, the Introduction, highlights the importance of better understanding mHealth in the workplace for theory and practice. This chapter further argues that mHealth scholarship could benefit from more systematically bringing in insights from the disciplines of Information Systems and Organisation Studies. Coordination studies is emphasised as a fruitful perspective to help integrate the insights from the different source disciplines.

- Chapter 2, the Setting, notes the importance of PHC in developing countries. It also highlights the important role of health intermediaries in assisting professionals (such as doctors and nurses) in working together to deliver PHC. The chapter proceeds to emphasise the difficult position of health intermediaries; as they are often tasked with responsibility for using mHealth, despite being only loosely integrated into broader healthcare systems. Nevertheless, and notably, limited financial compensation or recognition has not prevented them from delivering services at their own personal cost. Finally the history of mHealth in South Africa is situated relative to the health policy setting in the country.

- Chapter 3, the Literature Review, foregrounds the importance of workplace coordination in mHealth research, as is apparent from its regular surfacing over time in the literature, even when not the focus of studies. Elements of existing perspectives on coordination are integrated and particularised for mHealth. The relevance of the integrated perspective is then highlighted by using it to organise key references in health care coordination, including literature on HIT. Emerging research on mHealth is then interpreted using this integrated perspective to argue for the importance of three focussed research questions to build on recent research and address some remaining gaps in extant literature.

- Chapter 4, the Methodology, highlights the importance of the interpretive case study approach for understanding coordination in highly structured workplaces, such as health care. The appropriate character of the data collection methods is argued, and their key contribution demonstrated in relation to the interpretive approach. Finally,

the chapter argues for the particular suitability of the hybrid data analysis approach and the subsequent abductive extension of the coordination studies perspective.

- Chapter 5, the Case Analysis, highlights salient features of the case including the mHealth project, the setting of inner-city Johannesburg, and the constraints facing PHC clinics in addressing the needs of their clients. It then foregrounds the coordination mechanisms implicit in the officially recommended routines in the mHealth case under study, using the structure of the coordination studies perspective developed in the Literature Review. The analysis of the data from the field study that follows compellingly demonstrates that the actual routines differ from the official recommended ones, foregrounds the coordination mechanisms and identifies key influences from the cultural-historical setting. Finally the relevance of the unexpected findings from the analysis is emphasised with reference to extant literature and situated relative to the coordination studies perspective.

- Chapter 6, the Discussion, foregrounds the relevance of the analysis and unexpected findings to research, for both empirical understanding and theory. In order to demonstrate this clearly it is situated in the context of mHealth, as well as HIT more broadly. Finally the contributions and limitations of the study are emphasised.

- Chapter 7, the Reflection and Conclusions, highlights the relationship between the theoretical framing, relevance to the developing country setting and ethical concerns. It then argues for the relevance of the research to a number of related fields, foregrounding issues that deserve further investigation.

Chapter 2 **SETTING**

The setting for this research is the city of Johannesburg in South Africa, and the MomConnect registration process. The social and historical description of this setting below specifies how it differs from similar settings in both developed countries and other developing countries.

South Africa is one of the few countries in the world where child mortality has increased since the baseline set for the Millennium Development Goals in 1990 (Chopra et al., 2009). Destructive historical policies such as apartheid have contributed greatly to the challenges currently facing the South African health system. Failures in leadership and management rooted in these have been compounded by the impact of the HIV/AIDS epidemic (Coovadia et al., 2009). This has been mitigated to some extent by funding from international donors, for instance the US President's Emergency Program for AIDS Relief (PEPFAR) (Solarin & Black, 2013). There has also been a substantial increase in non-communicable diseases such as hypertension and diabetes that also impact negatively on maternal health (Coovadia, Jewkes, Barron, Sanders, & McIntyre, 2009).

2.1 **Historical background to Healthcare in South Africa**

Before the colonial era, South Africa's indigenous peoples had long-established traditional healing systems (Digby, 2008), while the first colonial settlement, on the site of present-day Cape Town, was set up by the Dutch East India Company in 1657 as a supply station offering fresh fruit and vegetables to prevent scurvy among sailors (Wikipedia, 2020). However, the formal Western medical healthcare which is the focus of this study was introduced to the majority African population by missionaries somewhat later, with mission stations remaining the primary points of delivery until the late Nineteenth Century (Sweet, 2017).

The discovery of diamonds (1865) and then gold (1883) resulted in a demand for large quantities of cheap labour. The British, now the major colonial authority over much of what was to become South Africa, introduced a new Poll Tax payable only in cash to force African people off the land and into the mines (Callinicos, 1980). The gold mines introduced the region's first systematic, mass-scale compulsory medical examinations (but for African males only) (Packard, 1987).

After the formal introduction of apartheid in 1948, all South African health care was segregated according to official racial classifications. PHC clinics and centres for the black population were promoted in the 1940s, partly because of concerns about the impact of poor health on the productivity of mine workers, but only around 40 were established (van Ginneken, Lewin, &

Berridge, 2010). The apartheid regime's establishment of black "self-governing homelands"[1] from the 1970s often did not improve PHC substantially, due to poor organisation and management (Kautzky & Tollman, 2008). Indeed, the forced removal of black communities to these "homelands" affected their social fabric as well as their economic and health status (Mazur, 1988). People classified as white had access to better public health care facilities, and the wealthier could also purchase services from a growing private sector.

Following the abolition of apartheid in 1994, primary care at public sector clinics was provided free of charge to all (Walker & Gilson, 2004). This was associated with a move to promote PHC under the newly elected democratic government, and expand the provision of basic services such as purified water and electricity to the population at large (Kautzky & Tollman, 2008). The ability of the public sector to provide these services effectively has however fallen short of its original aims for a multiplicity of reasons, including poor management (Coovadia et al., 2009) and corrupt activities at various levels (Hunter, 2018).

The failure of the South African government to freely provide anti-retroviral therapy (ART) to control HIV/AIDS despite the high incidence of the virus in the 1990s and early 2000s has been extensively documented, as has its disproportionately high impact on the black population (Palitza, Ridgard, Struthers, & Harber, 2010). After years of intense pressure from the medical community and activists, this policy was reversed in 2007. Early improvements in the rate of maternal mortality since 1994 have, however, been reversed by the increase in the number of pregnant women who are HIV+ (Chopra et al., 2009). Improved delivery of maternal health care as well as better monitoring is therefore a priority for the South African National Department of Health *(op cit.)*.

Improving the quality of public health care has been complicated by the constitutional delegation of powers between national and provincial governments, which specifies that health care falls under provincial authority (de Vos, 2011). The national Department of Health is limited to performing an oversight and coordinating role, and allocation of budgets and operational control both rest with provincial administrations. Some provincial health departments are poorly managed and their budgets have been diverted elsewhere, which has reportedly led to the complete collapse of services in certain regions (Hunter, 2018).

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[1] Homelands or Bantustans were created under apartheid by the Bantu Citizenship Act of 1970. Black people were allowed to own land and vote as legal citizens in the homeland designated for their particular ethnic group, but not in the major urban centres that were all classified as White ("The Homelands," 2011). The terms Homeland or Bantustan were widely rejected for being part of the justification for apartheid.

2.2 **Primary Health Care and the NHI in South Africa**

PHC services are offered at a number of clinics, which are situated in both urban and rural areas. This typically includes providing antiretroviral therapy (ART), treating tuberculosis (TB), dispensing other chronic medication (e.g. for epilepsy), antenatal care (ANC) and vaccinations for children under 5 years of age (see Table 1 below). Clinics are open during work hours in the week (8am to 4pm), and are typically managed by a registered nurse. The clinics are distinguished from larger facilities called community health centres, which are open around the clock, and provide additional services such as male circumcision (National Department of Health: Republic of South Africa, 2015a). The official description of a clinic and the services to be rendered there is presented in Table 1 below. Full details of this information for all categories of health facilities are provided in Appendix A.

Type	Description
Clinic	
Summary	This health facility normally functions only on weekdays during working hours. Antenatal care is one of a number of activities in the clinic, the others being chronic diseases, child health, family planning, etc.
Functions	• Antenatal care for low and intermediate risk women, including point of care blood and urine testing. • Postnatal follow-up visits, including the provision of contraceptive services. • Referral of patients identified with risk factors for pregnancy complications to appropriate health facilities (according to referral patterns). • The immediate management of obstetric and neonatal emergencies.
Staffing	Professional nurses, enrolled nurses, nursing assistants, community health workers and a visiting medical officer.
Facilities	• All the necessities to run an antenatal clinic. • Equipment and drugs for obstetric emergencies (oxygen, ringer's lactate solution, magnesium sulphate, salbutamol). • Sterile delivery packs for unscheduled deliveries. • Reliable transport service for emergency transfer to an appropriate facility. • An effective communication system (radio or telephone). • Contraceptive Services including insertion of IUCD's and Implants.

Table 1 Official Description of Clinic Services (National Department of Health: Republic of South Africa, 2015a)

An important initiative to improve public health care is the proposed National Health Insurance (NHI) system (National Department of Health: Republic of South Africa, 2012b). This is an ambitious plan to upgrade the public health care system and eventually establish quality universal healthcare at both primary and tertiary levels (Naidoo, 2012; National Department of Health: Republic of South Africa, 2015d). Pilot projects have been rolled out in four provinces, but their success has been uneven. Contracting-in private sector doctors and obtaining the cooperation of the private health sector is part of the long-term plan, but scepticism persists among these groups (Health-E News, 2018).

However, these plans make the role and powers of health intermediaries subjects of even greater research interest. Health intermediaries are seen as another key component of the NHI, so that the provision of preventive health services to communities and existing infrastructure such as clinics can be improved (National Department of Health: Republic of South Africa, 2015d). A number of provinces have chosen to employ health intermediaries indirectly via NGOs (Schneider, Daviaud, Besada, Rohde, & Sanders, 2018). Early studies have noted that these initiatives are disorganised and uncoordinated in a number of cases (Malan, 2014; Schneider, Hlophe, & Van Rensburg, 2008), leading to a lack of direction and permanence among the intermediaries. In addition only some of them receive formal training and certification (Mottiar & Lodge, 2018) and they are unable to meet all of the expectations that are placed on them by the community (Austin-Evelyn et al., 2017).

Initiatives to achieve universal health coverage (such as the NHI) have been under way for over fifteen years in other developing countries (Lagomarsino, Garabrant, Adyas, Muga, & Otoo, 2012). The Brazilian Unified Health System (SUS) has been running since 1988 (Paim, Travassos, Almeida, Bahia, & MacInko, 2011), and substantial progress has been made in extending health services and improving health outcomes (Victora et al., 2011). Some universal health coverage initiatives, for example that in India (Reddy et al., 2011), need to accommodate the dominant role of the private sector in parts of the country (De Costa & Diwan, 2007). Others have promoted community involvement in, and accountability from, a predominantly public health system (Cornwall & Shankland, 2008). Systematic strengthening of existing health systems and incremental change have both been emphasised as important in scaling up interventions (Knippenberg et al., 2005; Smith, de Graft-Johnson, Zyaee, Ricca, & Fullerton, 2015).

More than a dozen large-scale health intermediary programmes have been recently identified in developing countries (Perry et al., 2017). Programmes that use health intermediaries to perform community outreach are common, and are recognised as an effective way to improve health

services to areas where clinics and hospitals are inaccessible or inadequate. However, large scale public health intermediary programmes are complex and hard to sustain (Perry & Crigler, 2014).

Because of these complexities, histories and social conditions, nurses and health intermediaries are not simply health professionals and workers. Their identities, activities and formal professional commitments are overlaid and shaped by the specifics of the setting they inhabit. Thus they may encounter urban-rural prejudices (Andersen, 2004), dysfunctional power relationships with clients (Jewkes, Abrahams, & Mvo, 1998) and moral objections to life-saving procedures such as abortion (Varkey, 2000), among others.

In such a landscape, researchers (e.g. McIntyre & Klugman, 2016) have identified the human capital resulting from personal experiences and relationships as possibly more important to effective service delivery than more formal measures such as training. Nurturing this capital is thus an important consideration in ensuring the success of mHealth. Empirical evidence suggests that friction between health professionals and intermediaries is not simply resolved by technology (Chib, Cheong, et al., 2012; Mukherjee, 2015).

2.3 mHealth in South Africa

mHealth has explicitly been described by the South African National Department of Health (NDoH) as one step towards the realisation of the NHI discussed above (National Department of Health: Republic of South Africa, 2015b). One of the attractions of mHealth compared to other health interventions is that it promises to enable developing countries to “leapfrog” over obstacles to improving health systems through making use of technology (Kimenyi, 2015). However research has not yet determined that mHealth is more effective than other types of intervention either in terms of health outcomes (Chib & Lin, 2018; Chib, van Velthoven, & Car, 2015) or financially (Tomlinson et al., 2013). This is discussed in more detail in section 3.2.

The most successful health interventions in South Africa since 1994 have tended to be national, but South Africa has not yet established an effective district health system (Chopra et al., 2009) for feeding information from local clinics to the district and national levels. Further, human factors can lead to the manual systems currently in place generating suboptimal statistical summaries (Nicola, Bradshaw, Phillips, & Dudley, 2013). mHealth offers one way to leverage national interventions in principle, but responsibility for implementation rests with provincial departments (National Department of Health: Republic of South Africa, 2012a). For all these reasons, it remains uncertain whether South Africa is yet prepared for large-scale mHealth implementation (Leon et al., 2012).

The challenge of the HIV/AIDS epidemic led to the implementation of a number of mHealth projects in South Africa (Crankshaw et al., 2010; Forrest et al., 2015; Wood, Kaplan, Bekker, Brown, & Rivett, 2008). Because of this proliferation, the NDoH applied a moratorium on new mHealth projects in 2010, reflecting concerns that the different projects could lead to duplication and the development of systems that were not interoperable (Leon et al., 2012). This was lifted in 2015 after a standard for interoperability (National Department of Health and CSIR, 2014) as well as an mHealth strategy (National Department of Health: Republic of South Africa, 2015b) had been developed. Progress towards the implementation of this standard has, however, been uneven (Masilela, Foster, & Chetty, 2014).

Haas (2016) has noted that large-scale mHealth initiatives in the public health sector require the successful coordination of a number of different types of organisations such as mobile operators, specialist platform and content providers, as well as funding sources whether governmental or extra-governmental. mHealth interventions potentially encourage changes in organisational relationships, and emphasises transparency and accountability from front-line staff in ways that may result in unintended consequences.

As one example, mHealth can introduce direct and rapid reporting links from staff in local clinics or hospitals to higher levels that are often a substantial departure from established bureaucratic procedures (Asangansi & Braa, 2010). This change, which has been documented in both developed (Varshney, 2014) and developing (Kumar et al., 2015; Ling et al., 2018) countries, holds the potential to shift relationships between health care professionals or between health care professionals and managers.

Where mHealth introduces new lines of communication between clients and health care authorities there is a potential for increased accountability and effectiveness. This holds the potential for a disruptive power shift (Asangansi, 2016) as middle managers may be left out of these arrangements. In South Africa under apartheid, nursing was one of the few professional career avenues open to black women, and was a high-status occupation at that time (Packard, 1996). After apartheid, a much wider range of opportunities opened to black women, and the status associated with nursing fell. This has been posited as one factor influencing the sometimes fraught relationships between hospital or clinic nurses and clients (Jewkes et al., 1998).

It is not yet clear whether mHealth will be able to sidestep the challenges associated with scaling that have been identified for other types of intervention (Prata, Passano, Sreenivas, & Gerdts, 2010), but integrating mHealth with existing health systems has been identified as an important success

factor for scaling (Haas, 2016). Health intermediaries are important in health systems around the developing world (see 2.2), and particularly to scaling efforts.

What is evident is that health intermediaries occupy a relatively vulnerable position in developing world health systems, and that the introduction of mHealth – or even discussion of the concept – may give rise to ethical dilemmas, especially if health workers use their own resources to try and fill gaps left by formal heath care institutions (Chib, Cheong, et al., 2012; Hampshire et al., 2016).

There thus remains a substantial and as yet unbridged gap in reconciling the research on strengthening health systems and the position of health intermediaries with the relatively recent research on health intermediaries in mHealth (see 3.2.1 for more detail). Both scholarship (Knippenberg et al., 2005; Perry & Crigler, 2014) and popular reports (teleSUR, 2017) suggest that large-scale health intermediary programmes face social, logistical and even political challenges. There is no apparent reason to believe that mHealth implementation will be immune from these challenges, making staff coordination of mHealth an even more pressing subject of study.

2.4 **Summary**

South Africa is one of multiple developing countries aspiring to implement UHC. In this context, increasing the number and responsibilities of health intermediaries in the public health system is seen as one way to improve the delivery of services to deprived communities. mHealth promises to improve the effectiveness of these intermediaries by providing them with tools that they can carry into the communities they wish to serve.

However the place of health intermediaries in the overall health system is unclear and sometimes contested, despite the large changes planned in public health care, and because of the relative lack of coordination between the national and provincial health care departments. A range of types of health intermediaries operate in the South African health system, but only some of these receive structured training and certification (Mottiar & Lodge, 2018). As a result their career options and security within the health system are unclear, and their employment benefits often limited, even as they are commonly expected to take on increasing responsibility for the successful implementation of mHealth. These dilemmas make it vital to expand both scholarly and practitioner knowledge about how mHealth is coordinated and its impact, as this research seeks to do.

Chapter Three below reviews extant literature, foregrounding engagement with coordination and HIT studies.

Chapter 3 Literature Review

Chapter 1 has noted the current scholarly debates on which this research builds; while Chapter 2 has delineated the specificities of the South African public healthcare context. Building on both of these, this chapter engages in detail with extant literature, locating in relation to scholarship the specific research questions developed to interrogate the coordination of mHealth in the workplace. The chapter develops a perspective that locates mHealth in the workplace in terms of coordination with existing work practices, drawing on research from both Organisation Studies (OS) and Information Systems. This coordination studies perspective supports a systematic description and analysis of mHealth in the workplace, and the development of novel theoretical insights potentially transferable to other settings.

The chapter begins by setting out the scope of, and methodology employed in, conducting its literature review. In subsequent sections, the literature on mHealth is examined, foregrounding the discussion of issues related to coordination in the workplace. Next, the utility of the coordination studies perspective in offering important insights on healthcare is demonstrated drawing on both IS and OS literatures.

In the closing sections, lacunae in understanding mHealth in the workplace are identified, drawing on IS literature, where relevant research is more developed than in the mHealth literature. Limitations on the transferability of these IS insights are discussed. Finally, specific research questions based on the chapter's engagement with extant scholarship are posed to address the identified gaps.

3.1 Approach to the Literature Review

mHealth is a relatively young field and falls at the intersection of a number of fields (Fiordelli et al., 2013). For the purposes of this research the most relevant ones are IS (Braa & Sanner, 2011; Sanner & Øvrelid, 2019; Varshney, 2014), mobile communication (Campbell, 2019; Chib et al., 2015) and OS (Okhuysen & Bechky, 2009; Pine & Mazmanian, 2017) as these span the central concepts identified in the Introduction. Other scholarship, for example that emphasising health outcomes, has proposed a narrower and more technical characterisation (Iribarren et al., 2017; Lee et al., 2016). However, research investigating the coordination of mHealth in the workplace warrants the inclusion of other fields for the organisational insights they bring.

IS, for example, has a well-established stream of research on the integration of technology in the workplace (Dourish, 2003; Leonardi & Barley, 2010; Orlikowski & Baroudi, 1991; Riemer & Johnston,

2014) and has also paid substantial attention to the domain of healthcare (Fitzpatrick & Ellingsen, 2013; Romanow et al., 2018; Varshney, 2014). The organisation of health care and particularly coordination between health care staff has studied for 25 years as an important issue in the analysis and design of Health Information Technology (HIT) (Engeström, 1995; Romanow et al., 2012; Sanner & Øvrelid, 2019).

Mobile communication is an intellectual home for much mHealth and related research from the perspective of the transformative potential of the technology (Chib & Chen, 2011; Chib, 2013; Pimmer & Tulenko, 2015) as well as the associated challenges (Barrett & Stephens, 2016; Stephens, 2018). OS only directly addresses mobile technologies to a limited extent (Mazmanian, Orlikowski, & Yates, 2013), but contributes a great deal of insight on the theoretical understanding of coordination in health care (Faraj & Xiao, 2006; Gittell, Seidner, & Wimbush, 2010; Pine & Mazmanian, 2017).

There is little extant research on how the three fields might be combined in order to understand mHealth in contrast to desktop HIT. However, some scholars (Wiredu & Sørensen, 2006; Wiredu, 2007) have researched the influence of mobile technology on workplace behaviour, and other have more recently started to integrate organisational (Asangansi, 2012, 2016) and formal social theory (Ling et al., 2018) into mHealth. This chapter revisits the topic in more detail in Section 3.2.1.

The multiple perspectives thus invoked demand a literature review that is both broad enough to identify key relevant research across fields, and deep enough to engage with current debates. A search on the Scopus database with the keywords “mHealth” or “mobile health” over the period 2008 to 2019 returned 6 186 results for journal articles alone – less than half of the total number of results when conference proceedings were included.

However, a scan of the articles revealed that most came from medical or medical informatics literature, and were concerned not with workplace coordination but rather with assessing evidence of health outcomes and the medical efficacy of these interventions (Agarwal, Perry, Long, & Labrique, 2015; Garritty & El Emam, 2006; Mosa, Yoo, & Sheets, 2012). The review did not focus on these.

Rather, to identify articles that were potentially more directly relevant, the tables of contents of an initial selected set of journals were reviewed. These journals consisted of a subset[2] of the AIS "basket of eight", as well as the journals Computer Supported Cooperative Work, Information Technology and Development, Mobile Communication, and New Media and Society. These four last titles were selected because their place emphasis on the coordination of health and ICTs on the one hand and health communication on the other. Articles identified from this search also dealt with related topics such as the use of other mobile technologies e.g. Personal Digital Assistants and general health information management technologies, e.g. Electronic Health Records (EHRs).

The abstracts of the articles identified in this way were skimmed, and those relevant to the topic of the research were downloaded for detailed reading. The reference lists were used to identify other relevant articles. Forward chaining was performed from key articles using Google Scholar to identify citing literature following similar themes, with priority given to review articles. Articles identified as particularly important from these reviews were acquired, and their references examined in turn. Through this process, literature for reviewing was assembled that had both appropriate breadth and rigorous depth.

3.2 mHealth in the Workplace

Considerable research has considered mHealth (Chib et al., 2015; Varshney & Mayora, 2007; Varshney, 2014). Much of it is concerned with the potential applications and benefits associated with this technology (Chib, 2013; Mapham, 2008; Pimmer & Tulenko, 2015), sometimes organized by focus (Forrest et al., 2015; Obasola, Mabawonku, & Lagunju, 2015) or assessments of the effectiveness of such interventions (Betjeman, Soghoian, & Foran, 2013; Lee et al., 2016; Tomlinson et al., 2013). The technological requirements for developing mHealth and the potential of the technology have been emphasised (Chib et al., 2015; Labrique et al., 2013), at the expense of a nuanced consideration of non-technical and social issues (Bentley et al., 2019).

In among this wealth of mHealth research, a number of scholars have noted changes in coordination in the workplace as an aside (Chib & Chen, 2011; Chipps et al., 2015; Mukherjee, 2015). This accumulating evidence has however been built upon in more recent research that has an explicit

[2] The journals selected were Information Systems Research, MIS Quarterly, the European Journal of Information Systems, the Journal of the Association for Information Systems and the Journal of Information Technology. They were selected for a detailed search because the initial survey had identified that they contained a high proportion of relevant and highly cited articles.

focus on the processes of coordination between health workers and clients (Anstey Watkins et al., 2018; Hampshire et al., 2016), and coordination between health workers (Ling et al., 2018).

Despite this extensive work, the coordination of mHealth with existing workplace arrangements has received little systematic attention (Chib & Lin, 2018). As a result it is important to integrate insights from different disciplines to better understand the processes by which this occurs.

3.2.1 Mobile Handsets and the Workplace

mHealth is based on the opportunities that mobile handsets and networks offer for improving communication and delivering healthcare services. The research history of mobile handset use in the workplace stretches back almost twenty-five years (Manning, 1996), although much of the early work was primarily descriptive of a then-new phenomenon.

More recent research on mobile handsets in the workplace has focussed on knowledge workers (Mazmanian, Orlikowski, & Yates, 2013; Sørensen et al., 2008; Wiredu & Sørensen, 2006). Research on knowledge workers has addressed issues such as enabling professionals to work on the move (Kakihara & Sorensen, 2002; Mazmanian, 2013), work-life balance (Mazmanian et al., 2013), security considerations, and the issues raised by "bring your own device" (BYOD) policies (M. A. Harris, Patten, & Regan, 2013).

Introducing mobile handsets to the workplace has made it possible for travelling knowledge workers to communicate with peers, clients and managers without being in a fixed office (Matusik & Mickel, 2011). This has made it possible for businesses to increase their productivity substantially (Sørensen et al., 2008). At the other end of the scale, workplaces have been changed by the extension of enterprise-wide systems such as Customer Resource Management to be available on mobile handsets too (Basole, 2008).

The emergence of these new workplace possibilities has led to contrasting outcomes. Research in North America has identified how the option of being in communication outside office hours has led certain knowledge workers to respond to work-related requests made by email (at times when calls would have been considered intrusive) (Matusik & Mickel, 2011). This technology-led option has been translated into a felt obligation to colleagues and managers to put in additional work and potentially neglect other (e.g. personal) relationships and obligations (Mazmanian et al., 2013; Stephens, 2018). More detailed investigation has revealed that people within the same group in an organisation may develop different types of relationships to their mobile devices, and that these differences may prove to be relatively stable over time (Mazmanian, 2013).

Some European countries have responded to these developments by amending labour legislation and requiring employers to explicitly agree such expectations with employees at the start of their employment (Fortune, 2017), or else restrict contact with employees outside working hours except for emergencies (Associated Press, 2014).

However, the impact of work using mobile handsets on non-knowledge workers has received less research attention (Boillat, Lienhard, & Legner, 2015; Stephens, 2018). Non-knowledge workers – and particularly lower status workers such as janitors, security guards and junior administrative staff – have been found to experience mobile handset use at work quite differently to knowledge workers (Stephens, 2018, Ticona, 2014). Managers and organisational policies tend to view lower-status workers using mobile handsets as associated with slacking-off and work avoidance, and try to limit it (Stephens, 2018). Recent research has identified that such policies can prevent non-knowledge workers from coordinating their work more efficiently, or even place them in danger in emergency situations where they may be restricted from mobile contact (Stephens, 2018).

These findings are particularly relevant to healthcare workplaces, where status has been found to be important. Stephens (2018) discusses the differences between doctors' and nurses' preferred modes of communication, and how this relates to issues of status and privacy. These issues include unwillingness to provide personal mobile numbers to work colleagues or to use personal handsets for work-related purposes. Doctors often prefer to use pagers rather than mobile phones because they can delay answering messages based on their professional assessment of the priority of each message. By contrast, nurses seek a rapid response from doctors when they need support.

In this way preferences, and use of mobile handsets by different levels of professionals, has been found to be shaped by their status and desire to maintain autonomy. This concurs with observations alluded to in passing in the mHealth literature, the field discussed in the next sections.

3.2.2 The Promise of mHealth

mHealth typically involves communication either in one direction (from a sender to a receiver), or in two directions (from a sender to a receiver and back again). This covers the majority of messaging-based mHealth systems, although some mHealth systems instead focus on promoting communication within groups e.g. between health workers (Pimmer & Tulenko, 2015; Scheepers, Scheepers, & Ngwenyama, 2006) and between information seekers (Chib & Lin, 2018). Other systems promote communication between groups (Chib et al., 2008; Kumar et al., 2015) but these are less common. The opportunities for and barriers to these different types of communication will

differ according to the types of sender-receiver relationships, and the types of groups, e.g. between peers or between different occupational groups.

Literature from within the mHealth field asserts that the technology has the potential to both enable the expansion of the range of health services provided and expand the reach of these services to previously inaccessible populations (Chib, 2013). However, studies from the perspective of medical research (Agarwal et al., 2015; Free et al., 2013; Tomlinson et al., 2013) suggest this has yet to be demonstrated in practice.

Some research has moved beyond generalised claims of the potential of mHealth to investigate the conditions under which effective integration with workplaces may be expected to occur. The Technology Acceptance Model (TAM) has been proposed as one way to understand the adoption of mobile phones in a healthcare setting (Chib, Lwin, & Jung, 2009). TAM has been adapted from innovation studies for use in the field of IS, where it has been employed extensively (Benbasat, 2007; Sykes, Venkatesh, & Gosain, 2015). TAM proposes a causal model relating adoption as an outcome to various measures including perceived ease of use and usefulness. However, it does not consider the influence of the organisational setting and provides little insight into how the different constructs contribute to effective workplace use.

The ICT4H model (Chib, Cheong, et al., 2012) proposes that the improved communication ICTs offer present four major potential benefits: the new opportunities provided by mHealth; the improved capabilities that become available to users; better social relationships; and improved access to knowledge. While providing structure for the claims made for mHealth, how the process of workplace coordination might work in specific settings was outside the scope of these authors' work.

3.2.3 Empirical Evidence on mHealth in the Workplace

Actual practices of mHealth coordination in the workplace have received far less empirical research attention than the technical requirements for mHealth development (Chib et al., 2015). A recurring theme in the literature is how mHealth implementation can empower health intermediaries to provide improved services to end-users and improve communication with health professionals (Chib et al., 2008; Chib, Cheong, et al., 2012).

More recently, specific practices of mHealth coordination in the workplace and their potential organisational implications have received explicit attention (Ling et al., 2018). However, even before the work of Ling et al. (*op. cit.*), indirect evidence of workplace changes had already emerged from numerous empirical studies of mHealth (see below). Early studies of mHealth projects described project implementations in terms of their desired outcomes and technology design. Even at this

stage there was evidence that relationships between health care staff shifted in the course of an mHealth project. The increased capabilities of health intermediaries have been identified as leading to tensions with health professionals (Mukherjee, 2015), who not infrequently dismiss the intermediaries as ill-informed, or even refuse to take information-seeking calls (Chib, Law, Ahmad, & Ismail, 2012).

The mHealth literature provides evidence of both technological empowerment and of health care staffers' emotional commitment to their clients. Staff seek to realise their commitment through the technology: e.g. a nurse experiences a web-based service for advising mothers as bringing the two parties closer together (Kumar et al., 2015). Realising this felt commitment also extends to staff providing mHealth services to clients at personal cost, whether as a matter of altruism (Hampshire et al., 2016), or as encompassing relationship-building between staff members (Ling et al., 2018). This suggests that ensuring sustainable mHealth interventions may well be more complex than technologically-focussed research has been able to explore. These limitations, but also the utility of related research from the field of HIT, will be discussed separately below in Section 3.4.1.

Research has provided some limited evidence that nurses welcome the introduction of mHealth services because of the perceived increase in professional status associated with this (Scheepers et al., 2006). However, this has not been confirmed in subsequent inquiries. Further, given that the number of worldwide mobile subscriptions increased from 33.9 to 104.0 per 100 inhabitants between 2005 and 2018 (International Telecommunications Union, 2020) this effect may no longer be evident. The coordination of mHealth by different levels of staff therefore remains an important issue for investigation.

More recently, mHealth research has begun to consider these questions from the perspective of the organisational implications of implementation (Asangansi, 2016). Asangansi (2016) employs the concept of institutional logics to explore the possibility that the less-hierarchical modes of communication supported by mHealth are at odds with the formal and bureaucratic characteristics of national health departments, substantiating this with examples where mHealth implementation led to some middle managers losing their authority as they were excluded from their previous role of monitoring the quality of aggregated data before it was fed back to the local level. One conclusion of this study was that mHealth implementation may lead to disruption of established organisational norms, and consequently threaten successful scaling up and sustainability.

Beyond what has been described above, however, the literature on health care staff coordination of mHealth, however, remains sparse, without the kind of theoretical grounding that could allow its findings to be transferred to other settings (Chib, 2013).

3.3 The Coordination of Health Care

It is well established that effective health care relies on the ability of health workers to coordinate their efforts to bring their expertise to bear in a timely and effective manner (Faraj & Xiao, 2006; A. Strauss et al., 1985). This section draws on the literature on coordination to develop a summary of insights on coordination in health care, as a step towards identifying transferable insights for mHealth in the workplace.

3.3.1 Why Coordination Studies?

Coordination has been proposed as a way to understand how organisations achieve their goals for over a century (Taylor, 1916, cited in Okhuysen & Bechky 2009). It is concerned with the integration of tasks in the workplace under conditions of interdependence and uncertainty (based on Faraj & Xiao, 2006). While the phenomenon has been studied over an extended period of time, there is no formal theory of coordination (Malone & Crowston, 1990). Instead, there is a plethora of studies of different types of coordination: interdependent tasks in a single work process (Crowston, 1997), between groups in different departments (Sanner & Øvrelid, 2019), in different industries (manufacturing (Chaouiya, Liberopoulos, & Dallery, 2000), software development (Schmidt & Simone, 1996), health care (Bardram, 2000)) and for different purposes (managing temporary organisational forms (Bechky, 2006), large-scale project management (Boland, Lyytinen, & Yoo, 2007)). In the field of IS there is a substantial body of research on coordination that is more than twenty years old ((Bailey, Leonardi, & Chong, 2010; Kling, 1991; Schmidt & Simone, 1996), including much research on coordination in health care (Bardram, 2000; Goh, Gao, & Agarwal, 2011; Romanow et al., 2018; Sanner & Øvrelid, 2019).

Efforts have been made develop a more systematic basis for studying the general phenomenon of coordination in organisations (Crowston, 1997; Schmidt & Simone, 1996), but there has been very little in the way of subsequent elaboration of these approaches. Even a more recent and less ambitious attempt (Okhuysen & Bechky, 2009) has seen limited adoption of the integrative framework proposed, with the notable exception of Pine and Mazmanian (2017). There has also been some work on developing mid-range theory (Jarzabkowski, Lê, & Feldman, 2012), but again later studies have attended more to exploring specific instances of coordination rather than further developing theory.

Given this limited consensus on the theorisation of the phenomenon of coordination, the broad research field dealing with coordination is termed “coordination studies” from here on. Similarly, the theoretical approach developed on the basis of this literature review and adopted in this research is termed the “coordination studies perspective”, to emphasise that it consists of a coherent set of principles, concepts and relationships rather than a formal theory.

3.3.2 Coordination in Organisations

Coordination is a key route for organisations to achieve their goals (Okhuysen & Bechky, 2009). It has been the object of research since the early twentieth century (Taylor, 1916, *cited in* Okhuysen & Bechky 2009), and is defined in this research as “the process of integrating organisational work under conditions of task interdependence and uncertainty” (*based on* Faraj & Xiao, 2006).

The early literature on coordination was concerned with the arrangement of manufacturing operations (Okhuysen & Bechky, 2009). More recent literature has been concerned with the mechanisms of coordination that describes how this process takes place. The move to service- and knowledge-based organisation required a shift in theorising, which is shifting attention towards the dynamics of coordinating (Jarzabkowski et al., 2012). For clarity, this research refers to coordination rather than coordinating except when discussing what was reported and observed from the field study (see Chapter 5).

Okhuysen and Bechky (2009) proposed in a highly cited synthesis article that coordination mechanisms may be understood as operating through the way that they support three integrating conditions: accountability; predictability; and common understanding. The different types of coordination mechanisms they identified from the literature may support one or more of the integrative conditions. The types of coordination mechanisms they identified were grouped under the headings of plans and rules, objects and representations, roles, routines and proximity, and their synthesis is presented in Table 2 below.

Coordination Mechanisms	Integrating Conditions for Coordination		
	Accountability	Predictability	Common Understanding
Plans and rules	Defining responsibilities for tasks	Defining responsibilities for tasks Resource allocation	Developing agreement
Objects and representations	Scaffolding Acknowledging and aligning work	Scaffolding	Direct information sharing Creating a common perspective
Roles	Monitoring and updating		Substitution Creating a common perspective
Routines	Hand-off work	Task completion/stability	Bringing groups together Developing agreement
Proximity	Visibility: monitoring and updating Familiarity: developing trust	Familiarity: anticipating and responding	Familiarity: store of knowledge

Table 2 Coordination Mechanisms and Integrating Conditions that Support Coordination (based on Okhuysen and Bechky, 2009)

Because other literature on coordination focuses on analysing examples of specific types rather than providing an overview, the following discussion of coordination is based on the synthesis of Okhuysen and Bechky (2009) presented above.

Plans and Rules

Plans refer to formally agreed and often documented ways of proceeding in an organisation, whether at a strategic or operational level. Early understandings of organisations located the responsibility for developing plans with managers who would then direct lower ranking members of the organisational hierarchy to carry these out (Fayol (1949) cited in Carter, 1986). Rules, by contrast, describe how the different parts of the organisation should relate and inform how any conflicts that arise should be resolved (Okhuysen & Bechky, 2009).

Plans and rules contribute to coordination by defining responsibility for different tasks. In the field of health care, plans and rules define the distinct responsibilities of the different health occupations, e.g. in hospitals, doctors are responsible for diagnoses and prescribing treatment plans, while nurses are responsible for carrying out routine duties such as drawing blood samples (A. Strauss et al., 1985). Plans and rules also contribute to coordination by helping to resolve how limited resources should be allocated to complete various tasks (Crowston, 1997). In health care, one example is the allocation of patients to operating theatres according to an agreed schedule to optimise resource allocation (Bardram, 2000).

Objects and Representations

Technologies (such as information systems and mobile phones), physical objects and other representations assist coordination in various ways. Computer models, for example, help different members of an organisation coordinate their work by transferring information between them and thus achieve common understanding (Bailey et al., 2010; Leonardi, 2013).

Objects and representations also help to coordinate work by structuring activities, and reminding role-players about who must do which work to bring it to completion. Crowston (1997) describes how software was used to track software development problems and assign them to different team members, ensuring that each one was assigned (ensuring responsibility) and all were formally closed off (completion).

Another function fulfilled by objects and representation is helping organisational members from different areas to acknowledge and align their work. Architects design computerised representations of buildings, which are then passed to engineers, who then need to ensure that the building as

designed can actually be built (Boland et al., 2007). If the design cannot be built as specified this must be discussed and resolved, and in so doing work is aligned.

This kind of shared understanding of work practices is especially important where members have diverse skill sets and work under intense pressure, as in emergency admissions at a hospital. Medical protocols provide standard descriptions of the procedures and dosages of medicines for treating certain conditions (Faraj & Xiao, 2006; Timmermans & Berg, 1997). Both doctors and nurses are aware of these protocols, although the different professions are responsible for implementing different aspects (A. Strauss et al., 1985). Sharing this understanding helps all groups coordinate their work.

Roles

Roles are formal or informal designations that associate specific responsibilities with social positions, and help people understand who does what (Okhuysen & Bechky, 2009). They help coordination by structuring how individuals interact, either by reporting on their own progress or by checking up on others.

Roles are especially important in health care where the authority and competencies of different professions (e.g. doctors and nurses) are well-defined (Allen, 1997). Emergency admissions in a hospital require teams of doctors and nurses to coordinate their work rapidly, to ensure that patients receive appropriate treatment. Mutual recognition of the different roles helps support this coordination (Faraj & Xiao, 2006).

In a complementary fashion, having a shared understanding of the responsibilities of others enables people to substitute for one another on tasks. One example is ship navigation, where members with different roles on the navigating team can fill in for one another if needed (Hollan, Hutchins, & Kirsh, 2000).

Routines

Organisational routines are defined as “repetitive patterns of interdependent organizational actions” (Parmigiani & Howard-Grenville, 2011). Routines coordinate by bringing people together, identifying when task completion occurs and creating a common perspective on an activity.

One well-known routine in health care is the hand-over between different shifts of nurses (Munkvold et al., 2006; Randell, Wilson, & Woodward, 2011). Nurses gather in a particular location, typically the nurses’ station on the ward, at the end of each shift. The shift that has just finished then spends time giving information on new cases on the ward, particular problems that that require

special attention, and relevant background information such as previous admissions for the condition. The new shift asks questions to better understand the situation on the ward so that at the end of the hand-over they feel prepared to take responsibility for the well-being of the patients. Another common routine fulfilling a similar function in hospital health care is the ward round (Lewin & Reeves, 2011).

This research employs routines such as these as an organising framework for its analysis of coordination mechanisms derived from the field study. This approach builds on the work of multiple scholars (Goh et al., 2011; Leonardi, 2011; Pentland & Feldman, 2008) who propose routines as a mechanism for understanding how information systems function to coordinate activities in organisations. Goh et al (2011) specifically employ routines to analyse the successful implementation of HIT. How this choice of organising framework is implemented in presenting the analysis of coordination mechanisms is discussed further in the Methodology chapter (see 4.4.2), and examples are given in the Case Analysis (see for instance 5.3.1 and Table 17), and their changes over time (see for instance Figure 12).

Integrating Conditions

Okhuysen & Bechky's 2009 synthesis notes that the multitude of coordination mechanisms described in the literature were largely left unrelated to each other, or to the underlying processes that enabled their success. They thus proposed that coordination mechanisms could be understood, as noted above, in terms of three integrating conditions: accountability; predictability; and common understanding. This contribution created a framework that provided a basis for understanding why a mechanism was effective outside the particular setting in which it was identified.

Scholars have approached coordination from a number of different perspectives; some emphasising the content of what is being coordinated (Crowston, 1997; Malone & Crowston, 1990, 1994) while others focus more on how coordination occurs in specific settings (Faraj & Xiao, 2006; Jarzabkowski et al., 2012; Pine & Mazmanian, 2017). This makes it hard to compare findings, understand how coordination occurred through the mechanisms described and to derive generalisable insights (Okhuysen & Bechky, 2009).

The three principles proposed by Okhuysen and Bechky (2009) define conditions that coordination mechanisms realise in their different ways, and provide a basis for understanding the diversity of coordination literature. The three principles are described below in more detail drawing on Okhuysen and Bechky (2009).

Accountability. This describes who is responsible for different parts of a task. This has often been understood in terms of accountability between different levels of an organisational hierarchy and to help ensure adherence to organisational standards. Accountability is a broader phenomenon that can also be achieved by less direct means e.g. meetings between organisational members at the same level such as members of a nursing shift or the issue of public reports.

Predictability. This enables member of an organisation to understand the subtasks within an overall task, their sequence and who is responsible for each of them. In this way different members can plan their own work with an accurate understanding of when and how this will be integrated into the overall task. This can be achieved through formal means and also through implicit understanding. Examples of formal means include project plans and standard operating procedures. In contrast members of teams working in unpredictable environments develop ways to respond to uncertainty under pressure e.g. emergency admissions in a hospital (Faraj & Xiao, 2006).

Common understanding. This supports coordination through "providing a shared perspective on the whole task and how individuals' work fits within the whole" (Okhuysen & Bechky, 2009). It can be improved through understanding who is involved in a task, the strategies and steps needed to complete the task and knowledge of the environment e.g. the organisational goals that are being addressed through the task. Common understanding can be enhanced through the use of formal documentation such as schedules and plans that can be shared in a hierarchy, but also through the process of developing such artefacts together.

Assumptions and Limitations

However, the coordination studies perspective proposed by Okhuysen and Bechky (2009) (and the coordination studies literature more broadly) does have some limitations. Some of these stem from the setting in which the underlying research was developed: within predominantly formal, large-scale firms (Jarzabkowski et al., 2012; Okhuysen & Bechky, 2009). While healthcare workplaces are characterised by a high degree of coordination it is not clear that the perspective will also hold for small-scale settings where less formal arrangements may be more significant.

As another result of the setting where coordination was originally researched there is an underlying assumption of at most slow change in the overall objective that staff are working towards, and that that the structure of the organisation (and the place of staff within it) is also stable. The coordination studies perspective has been successfully used to research change processes (Jarzabkowski et al., 2012) as well as temporary forms of organisation (Bechky, 2006). This suggests that it has nevertheless has a wide range of useful application.

Using the Framework as an Analytical Tool

More recent research has drawn on Okhuysen and Bechky (2009) but has used it to categorise coordination mechanisms and not to engage with the integrative conditions (Hilligoss, Song, & McAlearney, 2016). This research extends the categories suggested by Okhuysen and Bechky (2009) to describe coordination in the field, and then draws on the integrating conditions to guide an analysis of the significance of the findings thereby uncovered (see 5.3).

For the purpose of analytical clarity the mechanisms described in Table 2 are grouped together. Plans and rules, roles, routines and proximity are all based on direct social arrangements and activities. These are grouped together under the heading of "social coordination".

The mechanism termed "objects and representations" by Okhuysen and Bechky (2009) is described here as "artefacts" to align more closely with the substantial body of IS research using this term (Bødker & Klokmose, 2011; Dobson & Nicholson, 2017; Orlikowski & Iacono, 2001; Ribes, Jackson, Geiger, Burton, & Finholt, 2013; Strong & Volkoff, 2010). Coordination mechanisms based on the shared use of artefacts take a wide array of forms. As such they form a group of their own, and are referred to as "artefact-based coordination". Social- and artefact-based coordination form important building blocks for an understanding of coordination.

A more process-oriented approach to coordination is proposed under the rubric of "relational coordination", advanced by Gittell et al (2002, 2013). Relational coordination describes the role of effective communication as well as that of the relationships in which organisational members are embedded (Gittell, 2002). In this view, coordination is "carried out through relationships of shared goals, shared knowledge, and mutual respect, or conversely through relationships that are characterized by the lack of shared goals, shared knowledge, and mutual respect".

Because relational coordination emerged from studies of health care (Gittell et al., 2013; Romanow et al., 2018), it is particularly relevant to this research.

Okhuysen and Bechky (2009) did not address the relational aspect of coordination. However it is of particular importance to the field of health care (Gittell et al., 2013; Konde-Lule et al., 2010). Relational coordination describes the place of developing and maintaining relationships in supporting coordination. Research on health care has emphasised the importance of relational coordination (Gittell et al., 2013). This research includes relational coordination (and relationships more broadly) as another important coordination mechanism, because of its importance in the health care workplace. This coordination studies perspective provides a relevant and useful analytical device and is summarised in Table 3 below.

Type of Coordination	Coordination Mechanism	Description	Examples from Health Care and Information Systems
Social Coordination	Plans and Rules	Formal organisational goals, resource allocation and procedures	The South African National Health Insurance White Paper (National Department of Health: Republic of South Africa, 2012b)
	Roles	Defined job descriptions and responsibilities	Doctors and nurses in health care (Allen, 1997; Ferlie et al., 2005; Mackintosh & Sandall, 2010)
	Routines	"Repeated patterns of behaviour that are bound by rules and customs" (Feldman, 2000, p. 611)	The ward round in hospitals (Lewin & Reeves, 2011)
	Proximity	Physical proximity between people	Meetings between medical personnel handing over between shifts (Randell et al., 2011; Stisen & Verdezoto, 2017)
Artefact Based Coordination	Shared use of Artefacts	Use of common artefacts by different groups in an organisation to promote shared understanding	The shared use of medical protocols (Timmermans & Berg, 1997) and Electronic Health Records (Bossen & Markussen, 2010) by different categories of health workers
Relational Coordination (Relationships)	Building and maintaining relationships	Building and maintaining relationships to promote trust and increase cooperation	(Gittell et al., 2013; Gittell, 2002)

Table 3 Types of Coordination in Organisations (based on Okhuysen and Bechky (2009) and Gittell et al (2013))

Combining the perspective proposed by Okhuysen and Bechky (2009) (see Table 2) with the types of coordination in Table 3 above can be represented schematically as groups of coordination mechanisms with cross-cutting integration mechanisms. This is presented schematically in Figure 1 below.

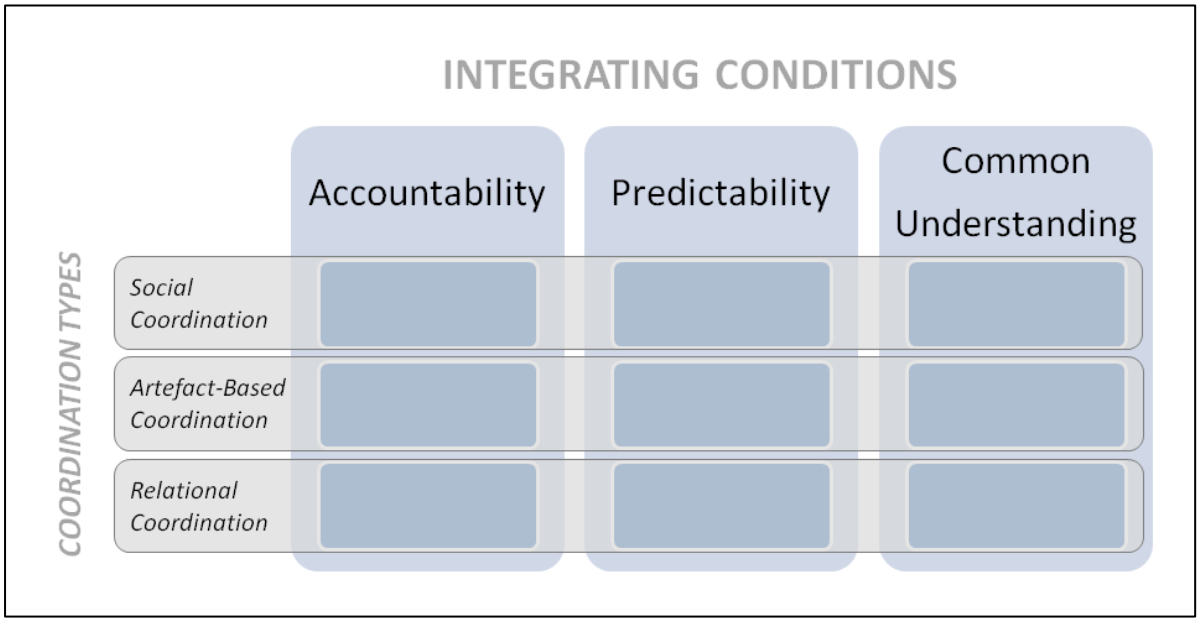


Figure 1 The Coordination Studies Perspective used in this Research (based on Tables 2 and 3)

The discussion above has traced how health care and information systems research has drawn on understandings of coordination. The sections below further detail the role of coordination in health care and relates this specifically to the literature on HIT.

3.3.3 Coordination in Health Care

This section demonstrates how the nature of health care workplaces is distinctive in terms of the consistent importance of certain types of coordination across different studies. The nature of these impacts is explored by reviewing the literature on coordination in different health care settings.

The healthcare workplace is characterised by the strong hierarchical relationships of the medical profession between doctors, nurses and support staff (Ferlie et al., 2005; Svensson, 1996; van Wieringen, Groenewegen, & Broese van Groenou, 2017). Authority is based on professional expertise (Anteby, Chan, & DiBenigno, 2015). Health care managers may struggle to exercise authority over senior doctors, who sometimes openly resent their lack of expertise (Currie et al., 2012). HIT is often resisted by doctors when they believe it poses a threat to their authority (Doolin, 2004; Kane & Labianca, 2011; Romanow et al., 2012). This has been suggested as one reason why ambitious HIT projects fail, or HIT-related functions are delegated to lower-status staff (Kane & Labianca, 2011).

Coordination in hospitals – social, artefact-based and relational – has been studied for over thirty years (Pine & Mazmanian, 2017; A. Strauss et al., 1985) even when mechanisms were not explicitly identified. Social coordination in the form of professional roles (Ferlie et al., 2005; Svensson, 1996)

and routines (Faraj & Xiao, 2006; Stisen & Verdezoto, 2017) has been identified as particularly important. In addition artefact-based coordination in hospitals has received considerable attention with studies examining the role of a range of artefacts including the medical protocol (Timmermans & Berg, 1997) and medical devices (Engeström, 1995). HIT as an artefact in coordination within hospitals has also received substantial attention (Berg, 1999; Sanner & Øvrelid, 2019; Stisen, Verdezoto, Blunck, Kjærgaard, & Grønbæk, 2016), something explored in some detail in section 3.4.2 below. Relational coordination has been researched since the early 2000s (Gittell et al., 2013; Gittell, 2002). However, the focus on hospitals has been pervasive and this review has identified how smaller institutions such as primary health care clinics have received less attention.

PHC clinics may comprise a number of different health professionals as well as health intermediaries. Informal social coordination has been identified as important in these cases (Belle Brown et al., 2009). The role of artefact-based coordination is far less developed than in studies of hospitals probably because there is less routine use of technology-intensive interventions such as surgery.

Health intermediaries are seen as important in extending health care to populations that do not have ready access to hospitals and clinics, particularly in developing countries (Schneider & Lehmann, 2016). This was discussed in some detail in Chapter 2. There is however little research on how coordination is carried out in developing countries between health professionals, or between health professionals and health intermediaries. Task-shifting from doctors to nurses in the treatment of HIV/AIDS has received some attention (Callaghan, Ford, & Schneider, 2010; Zachariah et al., 2009) and more recently research on the relative roles of health professionals versus health intermediaries has started to emerge (Mottiar & Lodge, 2018). Nevertheless, this research is fragmented and far less developed than that concerning health professionals. This research, focusing as it does on coordination between health professionals and health intermediaries thus addresses an important and relevant gap.

Several of the important studies listed above examined coordination in hospitals where HIT was being used (Gittell et al., 2013; Gittell, 2002; Pine & Mazmanian, 2017). The IS literature in turn has examined coordination as part of designing and evaluating information systems for more than 25 years (Kling, 1991; Malone & Crowston, 1990; Sanner & Øvrelid, 2019), with some attempts (Crowston, 1997; Schmidt & Simone, 1996) to formalise how coordination could be described to support design.

IS studies over this period have devoted extensive attention to the domain of healthcare (Fitzpatrick & Ellingsen, 2013). This attention has tended to focus on workplace studies and is thus well-suited to

informing structured research on coordination in PHC clinics. This research may be divided into research on specific instances of coordination (types of work) and research on themes of coordination (temporal coordination, coordination work on the move).

Specific instances of coordination include hand-offs between health professionals (Randell et al., 2011) and between health professionals and non-clinical staff (Stisen & Verdezoto, 2017), scheduling (Bardram, 2000) and medication planning (Bossen & Markussen, 2010). Coordination on the move (rather than coordination with mobile devices) has been studied by Yuan, Archer, Connelly, and Zheng (2010).

IS research on specific instances of coordination in health care have been largely descriptive, and the insights gained have been limited in their transferability to other settings, thus limiting their contribution to knowledge more generally (Fitzpatrick & Ellingsen, 2013). (This shortcoming was also identified in the wider coordination studies literature by Okhuysen and Bechky (2009).) A notable exception is Pine and Mazmanian (2017) who demonstrated how building on existing coordination frameworks enables research to develop incisive insights on health care work and HIT that would otherwise have been specific to the workplace under study.

Table 4 below organises key references from the literature on health care coordination using the structure presented in Table 3, to demonstrate the power of the coordination studies perspective that is developed here. This approach to understanding research on health care coordination gains power when it is further combined with the integrative conditions presented in Table 2. Section 5.3.5.6 uses this to analyse unexpected findings from the field work.

		Selected Health Care Coordination References		
Type of Coordination		**Coordination Mechanisms with Examples**	**Hospital / Hospital Unit References** e.g. General ward, trauma	**Other Health Care Workplaces** e.g. Solo practices, Clinics; Community Care
Health Care Coordination	**Social**	**Plans and Rules**: Formal professional identities and responsibilities of doctors and nurses	(Allen, 1997; Currie et al., 2012; Strauss et al., 1985; Svensson, 1996)	(Reay, Goodrick, Waldorff, & Casebeer, 2016; Reay, Patterson, Halma, & Steed, 2006)
		Roles: Professional authority and responsibilities of doctors and nurses in practice Coordination by non-clinical staff	(Faraj & Xiao, 2006; Lewin & Reeves, 2011; Lindberg et al., 2019; M. C. Reddy, Dourish, & Pratt, 2001; Salhani & Coulter, 2009; Valentine & Edmonson, 2014) (Stisen et al., 2016)	(Alberta Doctors Digest, 2005)
		Routines: Ward Rounds, Shift hand-overs	(Munkvold et al., 2006; Randell et al., 2011; Stisen & Verdezoto, 2017; A. Strauss et al., 1985)	-
		Proximity: Coordination on the move	(Ellingsen & Monteiro, 2003)	-
		Conditions of Change and Breakdown: Negotiation over non-standard treatments under urgent conditions Changes in Roles	(Faraj & Xiao, 2006; Munkvold et al., 2006; Pine & Mazmanian, 2017) (Kellogg, 2019; Reay et al., 2016)	(Reay, Golden-Biddle, & Germann, 2006; Reay et al., 2016)
	Artefact-Based	**Shared Use:** Standardised Protocols and Procedures Patient Charts, HIT, Mobile devices	(Bossen & Markussen, 2010; Timmermans & Berg, 1997) (Campbell & Rankin, 2017; Fitzpatrick & Ellingsen, 2013; Goh et al., 2011; Munkvold et al., 2006; Sanner & Øvrelid, 2019; Wiredu, 2007)	-
	Relationships	The development and maintenance of important relationships	(Gittell et al., 2013, 2010)	(Hampshire et al., 2016; Kalofonos, 2014; Maes & Kalofonos, 2013)

Table 4 The Coordination Studies Perspective (particularised for Health Care), with Key References (Literature Review)

3.3.4 The Significance of Cultural-Historical Setting

There is general agreement in coordination research (Jarzabkowski et al., 2012; Okhuysen & Bechky, 2009; Pine & Mazmanian, 2017), and organisational research more broadly (Johns, 2017), that the broader setting of the workplace is an important influence on which coordination mechanisms are dominant. Historically, formal plans and roles were prominent when researchers of coordination studied the large manufacturing and industrial corporations in North America common at the time (Fayol, 1949). More recently the service sector has become prominent, leading to greater emphasis on emergent coordination mechanisms because of the increased need for flexibility in these organisations (Okhuysen & Bechky, 2009). The section above foregrounds the importance of the specific characteristics of health care for workplace coordination. Particular examples are the dominant importance of professional identity and hierarchy in shaping social coordination mechanisms, specifically roles and routines.

This section builds on a research tradition that is more than twenty-five years old to make the argument that the broader policy, cultural and historical setting is also important in health care (Dopson, Fitzgerald, & Ferlie, 2008; Engeström, 1993; Igira & Aanestad, 2009; Sahay, Nielsen, & Aanestad, 2019). One example is the change in social norms, legislation and medical protocols around the certification of death (Sudnow, 1967; Timmermans, 1998). Medical protocols are fundamental to health care coordination. More recent policy shifts to a more managerial approach to health care delivery have also been documented as significantly changing coordination in the health care workplace as they challenge the dominance of doctors and other health care workers (Byrkjeflot & Jespersen, 2014; Waring & Bishop, 2010).

The research cited above has focussed on developed countries, but large-scale changes in developing countries are also associated with shifts in health care coordination e.g. international donor policies and the introduction of end-user fees for primary health care (Basinga et al., 2011), the reorganisation of treatment for HIV/AIDS (Georgeu et al., 2012; Harris et al., 2008) and the introduction of UHC (Cornwall & Shankland, 2008; Sahay et al., 2019). The treatment of the HIV/AIDS epidemic in South Africa provides a particularly relevant example where changed government policy increased the scope of work of nurses to include initiation of patients on HIV/AIDS medication, where this had previously been the domain of doctors (Georgeu et al., 2012).

More specifically there is an extensive literature on HIT in developing countries which also demonstrates the influence of setting on the coordination of health care at different levels (Braa, Monteiro, & Sahay, 2004; Rasmussen, 2018; Sahay et al., 2019; Sahay & Walsham, 2006). At the

national and regional levels HIT is strongly influenced by policies and institutional cultures (Noir & Walsham, 2007), the politics between different HIT service providers (Sahay, Monteiro, & Aanestad, 2009) and the contradictory institutional logics (Asangansi, 2012, 2016) between hierarchical government departments and networked IT solutions.

At the local level there is evidence that health care planning in clinics is redirected by shifts in the availability of donor funds (Rasmussen, 2018). The literature also shows that relationships between clinics and hospitals (Kumar et al., 2015) and between clinics and regional managers have also been shifted with the introduction of HIT (Asangansi, 2012, 2016; Bernardi, 2017). Taken together this literature demonstrates that the specific setting in which health care is coordinated, including HIT and by extension mHealth, needs to be given serious consideration. While a variety of theoretical frameworks have been used to in this research, what is common is the recurring reference to the elements of coordination. Most prominently this is the artefact of HIT or mHealth, but also including plans, roles and the relationships between health care staff. In other words, setting is both empirically and theoretically closely intertwined with coordination from national and to local levels.

Taken together with the founding assumption of the sociotechnical nature of mHealth (see section 1.5) this argument compellingly shows that coordination in mHealth needs to be considered in a broader policy, cultural and historical setting in order to adequately understand it. The setting for this research has been outlined in Chapter 2. The phrase “cultural-historical setting” (Engeström, 1993; Igira, 2008; Karanasios, 2014) is used from here on in this research to encompass all these elements of setting.

3.4 Implications of HIT Research for mHealth in the Workplace

Coordination is a perspective on HIT (and mHealth) that gives a central place to the ways that staff accomplish work together both intentionally and habitually. This research – drawing on insights from both IS and health care more generally – identifies coordination as an important perspective for research into HIT, that can produce improved insight on mHealth in the workplace, identifying social, artefact-based and relational forms of coordination as all of considerable importance in the health care workplace.

3.4.1 HIT and the Organisation of the Healthcare Workplace

This section argues that the literature on HIT and the organisation of the healthcare workplace has been primarily descriptive, and has focussed on the role of doctors in the coordination process. The role of other professions and occupations, and their interaction in influencing coordination

mechanisms (and routines specifically), have been neglected in comparison. The implications of existing literature is summarised at the end of this section.

The place of professional roles and associated hierarchy in health care institutions and the consequent rigidity of these organisations has been noted as an important influence in HIT research (Currie & Guah, 2007; Kane & Labianca, 2011). Numerous studies in developed countries have described resistance to implementation (Kane & Labianca, 2011; Romanow et al., 2012), extensive delays (Takian, Petrakaki, Cornford, Sheikh, & Barber, 2012) or even outright failure of HIT implementations (Fitzgerald & Russo, 2005). Effective coordination of HIT is therefore clearly highly contested.

Research has also provided evidence that HIT implementation also faces substantial obstacles in developing country contexts (Asangansi, 2016; Heeks, 2006). Scholars (Bernardi, 2017; Kimaro & Nhampossa, 2005) have suggested that the widespread problem of partial failure or unsustainable HIT implementation in developing countries may be related to the lack of institutionalisation of these initiatives i.e. the systems are not incorporated into the everyday work routines of health care staff. This is consistent with evidence from developed countries cited in the previous paragraph.

On a technical level the complex and cooperative nature of health care work can pose problems for IS implementation where design has been successful in meeting the needs of less diverse office-based work flows (Goh et al., 2011). The motivation for the implementation of HIT is often based on the improvements expected to general efficiency, communication and reporting (Bernardi, 2017; Hussain & Cornelius, 2009; Romanow et al., 2012). However, the front-line clinical staff bear the largest burden in achieving these benefits for the organization as a whole, and often experience few direct benefits (Bernardi, 2017; Pine & Mazmanian, 2017; Wears & Berg, 2005) in delivering health care. Prior research from the World Health Organisation reports that there is a low rate of doctors compliance to computerization procedures in primary health care, which has been noted as being “almost ubiquitous” (Tomasi, Facchini, & Maia, 2004), and HIT implementation in developing countries continues to report on the potential of the technology rather than cases of successful delivery. Finally, Romanow et. al. (2012) and Pine and Mazmanian (2017) confirm that health professionals still frequently struggle with HIT, even in developed countries.

Health care professionals make use of a variety of ways in which to record and communicate information, including patient folders, charts, oral instructions to colleagues and subordinates (Heath & Luff, 1996) in their daily activities. These are not easily translated into equivalent functionality in electronic systems (Neupane et al., 2014; Saleem et al., 2011). The established ways

of communication (pre-HIT) are also based on professional identity and relationships that are relatively set.

HIT systems with different functions (e.g. administrative or specialised clinical support) are common in developed countries (Furukawa et al., 2014; Sanner & Øvrelid, 2019), while in developing countries HIT is often rudimentary or even entirely paper-based (Nicola et al., 2013). However this lack of HIT could make developing country settings potentially more suitable for implementing mHealth solutions, since there are fewer established systems that need to be accommodated (Braa & Hedberg, 2002).

Shifting who does which work is loaded with implications for power relationships and workplace identity (Waring & Bishop, 2010), which is particularly important in the healthcare. There are few accounts of large-scale changes in health care arrangements that have shifted professional relationships or career options substantially, but some research is emerging (Reay et al., 2016) that indicates that this is possible where high status professionals are willing to accept these changes. Sometimes the opportunities that are opened up are seen as acceptable, but when they are rejected professional groupings prove very resistant to change.

3.4.2 The Coordination of HIT

Health professionals tend to view the use of information systems for data capture as a low-status task, and it is often delegated to nurses (Jensen & Aanestad, 2007; Kane & Labianca, 2011; Lluch, 2011). This has been interpreted as "user resistance" (Wu, Li, & Fu, 2011), which has been identified as a major issue that requires improved understanding if HIT deployment is to be successful (Romanow et al., 2012). The focus of studies on HIT has tended to be on hospital environments and physicians (Goh et al., 2011; Prgomet, Georgiou, & Westbrook, 2009; Weeger & Gewald, 2015), although primary health care has also received attention (Montague & Asan, 2012; Strong et al., 2009). Nurses' and non-clinical staffs' (e.g. hospital porters) use of IS in the health workplace has received little attention however.

Studies of HIT and coordination in the health sector have emphasized the importance of negotiations within the hierarchical relationships of doctors, nurses and support staff (Allen, 1997; Bechky, 2011). Doctor-nurse and inter-professional relationships have received most attention (Ferlie et al., 2005; Davide Nicolini, 2011; Svensson, 1996). Timmermans and Berg (1997) have described how even the implementation of medical protocols was negotiated between doctors and nurses in practice, despite the formal discrepancy in their relative authority.

In short, HIT research suggests that implementing mHealth at scale in existing health facilities will face organisational and technical obstacles that may well prevent the realization of envisaged benefits to the health system. Research on HIT coordination by nurses and health intermediaries has been neglected relative to that by doctors, and it unclear whether task-shifting between nurses and other health workers will occur. Further empirical research is required here.

Much HIT research has been done at the level of local workplaces (Al-Dorzi et al., 2011; Venkatesh, Sykes, & Zhang, 2011) or implementations of systems in different locations with limited interoperability (Takian et al., 2012), with restricted attention given to distributed systems (Fitzpatrick & Ellingsen, 2013; Tilson, Lyytinen, & Sorensen, 2010). Fitzpatrick and Ellingsen (2013) have argued that this HIT research is of limited value to policy makers because it can give little insight beyond the processes that are observed at the local level. mHealth offers an opportunity to study systems that not only use a novel care delivery method, but are also inherently distributed because of their implementation via mobile networks. Insights from studies of HIT (and mHealth) thus offer opportunities to generalise beyond the local site, and can generate more broadly useful insights as a result.

IS in health care settings is often fragmented, and there are also overlaps and redundancy between systems (Hanseth et al., 1994). These issues are generally seen as requiring elimination for the sake of efficiency (Agarwal, Gao, DesRoches, & Jha, 2010). The professionals responsible for care delivery may find that this "inefficiency" serves practical purposes because it corresponds more closely with the established divisions of labour in healthcare (Montague & Asan, 2012; Saleem et al., 2011), and the way that responsibility is handed over between teams in different specialities and shifts (Randell et al., 2011).

Coordination involves a number of mechanisms and processes which have often been applied piecemeal or with a very specific setting where only a small part of this framework is employed. As a result studies of coordination in the workplace have been limited in building on each other (Okhuysen & Bechky, 2009).

Routines (see 3.3.3) are a prominent feature of health care work and staff are able to readily frame their experience of the coordination work practices on this basis (Randell et al., 2011; Stisen et al., 2016) and they are also relatively easy to observe (Stisen & Verdezoto, 2017). In addition routines have been used successfully as a way to investigate HIT in the workplace (Goh et al., 2011). This research thus adopts routines as an entry point to studying the coordination of mHealth in the workplace.

3.4.3 Transferability from HIT to mHealth

So far much of this literature review has investigated insights developed in the field of HIT. This research argues that the insights provided by research into coordination and HIT are largely transferable to the domain of mHealth in the workplace for a number of reasons. First both HIT and mHealth in the workplace are characterised by the presence of medical professionals and their institutionalised coordination mechanisms. Secondly there are a number of studies in the IS literature on the use of handheld and mobile devices (not always mobile phones) that have identified the issues noted in this review (such as distinct roles and implications for device use) as relevant (Wiredu, 2007). Finally there are a number of mHealth studies that have noted similar issues of health care coordination as have been identified in HIT research, even when these issues have not been the focus of the study (Chib & Chen, 2011; Mukherjee, 2015). This is also evident in recent research on health communication (Stephens, 2018).

mHealth as a subset of mobile applications more broadly has specific features that suggest that there may be other distinctive issues that are not as evident in the study of HIT. Mobile handsets are perceived as personal items that involve considerations such as status, that are often used routinely and without concern for the technical complexity behind the because of the familiarity of the user interface (Middleton, Scheepers, & Tuunainen, 2014). They may also lead to conflict as the personal and workplace spheres start to overlap because their mobility means that it is no longer as easy to have a clearly defined boundary between the two (Mazmanian et al., 2013).

Developing generalisable (or transferable) insights from qualitative research requires the use of a theoretical framework or else the development of theory drawing on empirical evidence (Burrell & Toyama, 2009). There is a lack of mHealth research that is informed in this way (Chib et al., 2015), and could thus generate transferable insights, with the notable exception of Ling et al (2018). Theoretical frameworks that have been employed are not well suited to investigate coordination in detail, as they are often high-level such as social capital or a spatio-temporal perspective (Chib, Law, et al., 2012), or else draw on constructs that are not appropriate for in-depth analysis of a poorly understood phenomenon e.g. the Technology Acceptance Model (TAM) (Chib, Lwin, & Jung, 2009; Mohamed, Tawfik, Al-Jumeily, & Norton, 2011).

Another consideration in researching mHealth in a developing country setting is the importance of theorising the influence of the setting in the process of coordination (Davison & Martinsons, 2016; Romanow et al., 2012).

3.5 **Summary**

This review has identified what is known regarding mHealth in the workplace and process of coordination. General healthcare coordination as well as IS literature has identified that formal roles are important in influencing how coordination takes place. Doctors and especially specialists are likely to resist the introduction of information systems that they perceive as undermining their professional standing and authority. Task-shifting to lower status staff such as nurses was reported in several studies, and is consistent with the influence of formal roles as a coordination mechanism. Empirical studies have confirmed that dynamics such as those described above do emerge (Kumar et al., 2015; Mukherjee, 2015) in mHealth even when they are not seen as obstructive (Ling et al., 2018). These findings are pertinent even though mHealth studies thus far have not focussed on the influence of coordination in the workplace.

This literature review, however, indicates why coordination can be identified as a suitable approach for further investigating the remaining gaps in research. First, there is very little empirical research focussed on mHealth in the workplace and healthcare staff. The limited published research is largely descriptive rather than analytical, and does not systematically incorporate insights from HIT research on the influence of the nature of the medical profession.

Second, few theoretical frameworks have been proposed that could satisfactorily assist in generalising empirical results from different studies of mHealth coordination. Burrell and Toyama (2009) have described how the lack of an appropriate theory base contributes to the limited development of cumulative knowledge in the field of Information and Communication Technology for Development (ICTD), and thus about staff coordination of mHealth in developing countries. While there is some evidence from the literature (Chib et al., 2008; Chib, Cheong, et al., 2012; Mukherjee, 2015) that formal roles and power relationships affect mHealth coordination, it is primarily descriptive. Further, only limited research exists on how the coordination of health services via mobile handsets might differ from HIT implementations relying on the use of desktop terminals (Allen, Wilson, Norman, & Knight, 2008; Allen et al., 2013). As a result, there is currently little understanding of how insights from HIT and IS research can be employed to guide research on mHealth in the workplace.

Addressing these gaps could contribute insights with substantial utility for both research into, and the practical implementation of, mHealth. Recent substantial investments in digital health initiatives make this research particularly timely (Tabatabai, 2019).

3.6 **Research Questions**

Chapter 1 presented the integrative research question: “How is mHealth coordinated with existing workplace arrangements”? Section 3.5 above, together with the detailed exploration of previous scholarship and its lacunae laid out in the literature review, further provide starting points for the development of three subsequent focal research questions, formulated in terms of the concepts of the coordination studies perspective, which are presented below.

This literature review has clearly established that mHealth in the workplace can fruitfully be understood in terms of coordination with existing and new work practices. This perspective is particularly suitable where mHealth has been designed to fit smoothly into existing ways of accomplishing work rather than attempting to radically transform them. This provides the foundation for Research Question One:

“What are the coordination mechanisms evident in mHealth in the workplace?”

Understanding of the setting of the research site and PHC in South Africa enables answering questions of influences from outside of the immediate research setting. This leads to Research Question Two:

“How do the workplace and broader cultural-historical setting affect this coordination?”

Analysis of the coordination mechanisms that support the integration of mHealth into existing work practices can shed light on how and why mHealth in the workplace takes the forms that it does (routines). Thus Research Question Three is:

“How do the coordination mechanisms and setting influence the routines that develop?”

The coordination studies perspective that relates mechanisms and integrating conditions enables the synthesis of the findings to the research questions above, and the systematic development of new knowledge.

Chapter Four below describes and discusses the methods employed in seeking to answer these questions.

Chapter 4 **Methodology**

This chapter makes the case for an interpretive case study research design as particularly appropriate in order to explore the phenomenon of mHealth in the workplace. It thus highlights how the field data is interpreted in terms of the coordination studies perspective developed in Chapter 2, and the use of induction, deduction and conceptual reasoning to abductively develop new insights (Sarker et al., 2018; Timmermans & Tavory, 2012) from the analysis. Because the focus of this research is on the integration of mHealth with existing workplace arrangements and the use of cell phones is not seen as distinct from established practices, mHealth needs to be explored as part of routine activity rather than as a distinct phenomenon. This form of analysis builds on established qualitative approaches in a pragmatic way (Sarker et al., 2018)

In particular it shows how open-ended interview transcripts and field notes from non-participant observation are analysed together. A hybrid approach to coding and analysis (Miles, Huberman, & Saldaña, 2014; Saldaña, 2013) is foregrounded to compellingly demonstrate how it effectively addresses the research questions.

4.1 **Research Paradigm**

This research draws on the interpretive research paradigm (Walsham, 1995; Walsham, 2006) in order to uncover how mHealth in the workplace is coordinated as part of healthcare practices. This approach was selected because it directs attention to the practices, priorities and concerns of the healthcare staff to develop an understanding of coordination as grounded in everyday activity. It also provides a richer understanding of the phenomenon than abstract models of IS adoption and use (Benbasat, 2007; Venkatesh et al., 2011) that can obscure habitual, emotional and other motivations for routine use in the workplace (de Guinea & Markus, 2009; Riemer & Johnston, 2014).

Some authors (e.g. Matavire & Brown, 2011) have noted that some research strategies associated with the interpretive paradigm, for example Straussian grounded theory methodology (GTM), position the researcher as a detached analyst of data extracted from the research setting. However, this is not the only possible positioning. The stance adopted in this research, by contrast, is one where the researcher situates himself as part of the social context in which the research takes place (Charmaz, 2014; Krauss, 2013). This reflexivity helps provide insight into how the identity and social position of the researcher influences the collection and analysis of the accounts given by the clinic staff.

Chapter 2 discussed PHC in developing countries with specific reference to South Africa and mHealth, drawing on the key concepts presented in the Introduction, thus situating the phenomenon of mHealth coordination in the social and historical conditions of South Africa. South Africa is still deeply affected by the structural legacy of apartheid, resulting in the persistence of deprivation closely associated with race, as well as conscious and unconscious prejudice. For this reason, it is an important principle that this researcher clarifies his social position and identity as it relates to the socially divided and stratified context of South Africa (Krauss, 2013). These aspects strongly influence what a qualitative researcher uncovers when engaging in fieldwork. Klein and Myers (1996) have proposed an integrated set of principles encompassing these aspects; the principles and their descriptions are set out in Table 5 below.

Principle	Description
1.Fundamental Principle of the Hermeneutic Circle	Iterate between considering the interdependent meaning of parts and the whole that they form. Fundamental to all the other principles.
2.Contextualization	Reflect critically on the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.
3.Interaction Between the Researcher and the Subjects	Reflect critically on how the research materials (or "data") were socially constructed through the interaction between the researchers and participants. [3]
4.Abstraction and Generalization	Relate the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts.
5.Dialogical Reasoning	Engage with sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and findings with subsequent cycles of revision.
6.Multiple Interpretations	Engage with sensitivity to possible differences in interpretations among the participants as typically expressed in multiple narratives of the same sequence of events under study.
7.Suspicion	Engage with sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants.

Table 5 Interpretive Principles of Klein and Myers (adapted from Klein and Myers (1999))

The principle of the hermeneutic circle requires meaning to be synthesised as part of an iterative movement between the elements of the study - for example between findings and theoretical framework - refining this, and then reflecting on the implications for the rest of the research. Interpretivism is concerned with identifying meanings constructed in social interaction between humans (Barrett & Walsham, 2004), which is why this principle is foundational to the approach.

[3] Reflexivity, or reflection on the role of the identity and social standing of the researcher in this social construction is a logical extension of this principle (Charmaz, 2014).

Contextualisation requires engaging with the social and historical background of the research setting. This is particularly necessary for a developing country. In South Africa, it requires engaging with issues such as the emergence of the country from apartheid and the persistent widespread poverty and pockets of wealth, with very different levels of public and private health care. As noted in Chapter 2, nursing provided black women under apartheid with a rare opportunity to become a professional (Packard, 1996), but the situation has changed substantially since 1994, with the profession now perceived as far less attractive (Breier, Wildschut, & Mgqolozana, 2009).

A further principle of interpretivism is that valid evidence does not consist of "objective facts" to be discovered by a dispassionate researcher (Sarker et al., 2018). As Charmaz (2014) notes, meaning and events are constructed not only as part of the interaction between the researcher and participants, but also as a result of their broader social status, identities and backgrounds. Interviews, casual conversations and observation sessions are not simply about the collection of information, but need to be interpreted as a process of socially-situated interaction (ibid.). Thus issues of power differentials, status and self-presentation all need to be considered in this process, in line with the principle of the interaction between the researcher and the subjects. This also has implications for the writing of the research, for example, taking care to present an account that does not erase how the author is implicated in these issues (Charmaz & Mitchell, 1996).

The material developed in the process of construction described above then needs further analysis. This is undertaken by applying the first (hermeneutic circle) and second (contextualisation) principles to interpret the findings, and relating these interpretations to theoretical concepts and existing literature in an iterative process (principles five). This process leads to abstraction and generalisation, and potentially to the development or extension of theory as per principle four.

The principle of dialogical reasoning requires flexibility and sensitivity when considering how theory informs and possibly constrains the research interpretations. When these findings challenge expectations created by the theory in use, this should prompt re-examination of both the theoretical framework and the evidence. The study of inter-professional work in healthcare innovation by Ferlie et al (2005) provides an instructive example of how an initial theoretical framing was attempted, found lacking, and then replaced with a more appropriate framing. Ferlie et al.'s (ibid) research investigated how medical innovations spread inside a large healthcare organisation, employing a multiple case study to investigate the processes driving adoption in contrasting cases.

Sound medical evidence was assumed to be an important driver of acceptance given the importance attached to solidly-based choices in the medical profession. Several innovations with strong

evidence-bases failed, while some with much weaker supporting evidence were successful. This prompted a return to the evidence and the interpretations that had been made. On reflection it was concluded that strong professional boundaries rather than weak evidence resulted in non-adoption, despite prior theory arguing that professionalisation contribute to the rapid spread of innovations (Lave & Wenger, 1991). This prompted the researchers to focus on communities of practice as a more appropriate research lens (Ferlie et al., 2005).

Finally, there is a close relationship between the principles of multiple interpretations and suspicion. The former requires respect for the multiplicity of accounts emerging from research participants, rather than presenting a single account that avoids inconsistencies as irrelevant detail. The latter requires taking this principle further, applying it not simply to multiple accounts, but also to taking individual accounts at face value, which may result in (intentional or unintentional) manipulation of the findings. Individual accounts warrant suspicion because they may be coloured by issues of identity, fear of retribution or self-preservation.

Interpretive research thus provides a means to investigate phenomena such as coordination in a way that emphasises human perceptions, activities and workplace organisation as experienced by the informants. Its proven utility in drawing out these aspects supports the focus of this research.

4.2 **Research Design**

This research explores how mHealth is integrated into existing workplace arrangements by health care staff, in order to better understand how this process unfolds in a naturalistic setting. Researchers undertaking this type of study have commonly employed the approaches of action research, case study research and ethnography (Darke, Shanks, & Broadbent, 1998). This research adopted a case study approach because it supports the analysis of the phenomenon in its setting and thus as part of general work activity, rather than with a more restrictive focus on data and information management (Markus & Lee, 1999).

4.2.1 The Case Study Approach

The distinctive contribution of the case study approach has been recognised since at least the 1980s (Benbasat, Goldstein, & Mead, 1987; Darke et al., 1998; Flyvbjerg, 2006). Many authors have focussed on the role of case studies in the interpretive approach (Andrade, 2009; Bygstad & Munkvold, 2011; Keutel, Michalik, & Richter, 2013; Walsham, 1995). However it has also been argued that the case study may be used in the context of positivist research (Cavaye, 1996; Yin, 2002). Despite this divergence there is general agreement that case studies are particularly well suited to exploring phenomena where there is limited understanding and the interaction between

the phenomenon and the environment is critical (Benbasat et al., 1987; Darke et al., 1998; Keutel et al., 2013).

This research employs a case study approach, appropriate for situations where the phenomenon (in this case, of mHealth coordination by clinic staff) is not well understood (Chib & Lin, 2018), and is theoretically poorly developed (Ling et al., 2018). Additionally, this approach has demonstrated utility in exploring a specific example of the phenomenon in context, and in this way develop new insights (Cavaye, 1996; Flyvbjerg, 2006; Yin, 2002).

Research (e.g. Street & Ward, 2012) suggests that changes observed over an extended period can lead to improved understanding of empirical processes, and thus greater theoretical insights. For this reason, the field study was conducted over 15 months, and two periods of interviews and observations were used to assess how mHealth in the workplace changed over time.

4.2.2 Case Selection

The MomConnect mHealth project was rolled out to all public PHC clinics in South Africa in August 2014 (South African Government News Agency, 2014b). Nurses and health intermediaries are responsible for registering pregnant women so that they can receive informational text messages related to their stage of pregnancy. MomConnect registrations are meant to be integrated into routine antenatal clinic (ANC) attendances. MomConnect has been designed so that different staff members can be assigned responsibility for the various parts of the registration process (RMCH, 2014).

Because the MomConnect initiative is explicitly designed to fit in with the existing routines carried out in ANC consultations (see Table 15), it is particularly suitable for exploring the questions posed in this research of how the coordination of mHealth takes place. MomConnect is designed to draw on existing staff, existing (personal) cell phones and established routines. MomConnect registration in clinics is a relatively simple process taking place in a structured healthcare environment, where routine coordination practices could be expected to play a prominent role in influencing how registration is integrated into the workplace.

Three agencies were appointed to perform training for clinic staff nation-wide in August 2014 on the use of MomConnect. One of these agencies was the Wits RHI (then the Wits Reproductive Health Institute). Three meetings were held in 2014 with between the researcher and the mHealth project manager at the Wits RHI located in Hillbrow, Johannesburg. The Wits RHI is associated with the University of the Witwatersrand, located nearby. Access to three inner-city clinics was negotiated through the Wits RHI in order to perform field work there. Twenty-three interviews were conducted

at these three clinics over a period of fifteen months, starting in March 2015. The number of interviews at each site is detailed in Table 6 below, and the profiles of clinic staff are given in Table 7 immediately following.

Interviews	Clinics		
	Clinic A	Clinic B	Clinic C
No of Interviews (2015)	5	4	4
No of Interviews (2016)	3	3	4
Different Individuals Interviewed	6	5	5

Table 6 Summary of Interviews in Clinics where Field Work was Conducted (Researcher's Data)

Table 7 below summarises the staff profiles of the three clinics visited.

Facility	Year	Facility Manager	ANC Nurses	Health Intermediaries
Clinic A	2015	Registered Nurse	1	3 (1 later resigned)
	2016	Registered Nurse	1	2
Clinic B	2015	Registered Nurse	1	1
	2016	Registered Nurse	2	1
Clinic C	2015	Registered Nurse	2	1
	2016	Registered Nurse	1	1 + 4 (WBOT members)

Table 7 Summary of Facilities and ANC Staff Make-Up (Researcher's Data)

4.2.3 Units of Observation and Analysis

Karanasios (2018) discusses the importance of observing and analysing the smallest unit where a phenomenon may be studied without losing the complexity of the activity, but which nevertheless accounts adequately for relations between individuals and broader cultural-historical conditions. In line with this, and in this context, the PHC clinic provides the most appropriate unit of observation for this research.

Because the research aim is to better understand mHealth in the workplace; the most appropriate unit of analysis is those groups of people conducting mHealth coordination in a healthcare organisation: the clinic nurses and health intermediaries. The theoretical findings of this research are thus also likely to apply to other teams of healthcare workers in similar settings, and possibly to other frontline service workers.

4.2.4 Transferability

Because the term transferability is preferred to generalisability by researchers in the interpretive tradition (Gregor, 2014; Lee & Baskerville, 2003; Sarker, Xiao, Beaulieu, & Lee, 2018; Walsham, 1995), it is the term employed throughout this dissertation. Interpretive research may be used to generalise from specific descriptions or observations to more abstract statements through induction (Barrett & Walsham, 2004; Charmaz, 2014). These abstract statements may then be related to each other to develop or extend theory (Andrade, 2009; Lee & Baskerville, 2003; Saunders et al., 2018).

This research does not rely solely on induction and a data-driven approach but employs conceptual reasoning, and reference to established theory and literature, as the inferential logic (Ngwenyama, 2019) (see 4.2.5 below) to derive transferable findings through abduction. As a result, the scope of transferability that is claimed is not limited to similar empirical settings, but is also extended to conceptually similar settings and phenomena (Seddon & Scheepers, 2012).

The unit of analysis employed in this research (see 4.2.3 above) is such that its contribution is transferable to other groups of people working in healthcare organisations, under similar cultural-historical conditions. The case study approach employed, as indicated above, is appropriate to develop a detailed understanding of how mHealth is integrated into the workplace by staff in a PHC clinic setting, and to provide rich insight into the implications of this new technology (Cavaye, 1996). This empirical account is then analysed to develop a theoretically-informed understanding (Eisenhardt, 1989; Walsham, 1995) that may be transferred to other, similar cases (Lee & Baskerville, 2003; Seddon & Scheepers, 2012).

4.2.5 Use of Theory

Walsham (1995) discusses how theory may be used to inform the initial process of research design and data collection; to guide successive cycles of data collection and analysis; and as a major contribution of the research. This research uses the coordination studies perspective presented in Chapter 3 to guide the research design, and inform the data analysis. However, a conceptual framing of coordination derived solely from the literature cannot account for all of the findings emerging from the data. For this reason, the case analysis then employs abduction (Sarker et al., 2018; Timmermans & Tavory, 2012) to develop transferable insights from these findings (see section *4.4*).

This process of developing broader insights from unexpected findings is informed by the data, as well as prior theory and the literature and is thus an abductive analysis (Timmermans & Tavory, 2012). This necessarily involves a creative reasoning process (Behfar & Okhuysen, 2018; Bruscaglioni, 2016) and argumentation in addition to careful data analysis. Abductive analysis is thus followed in

Chapter 5 to develop insights from unexpected field study findings; in order to extend the coordination studies perspective (see Figure 1).

An explicit criterion is needed to judge when enough evidence has been gathered from the field to provide a sound basis for theory development (Saunders et al., 2018). Since this research uses an abductive approach to data analysis and theory development, relating empirical findings to extant theory and literature, a process of inductive analysis was first followed until no further themes or codes were indentified from the cycle of data collection and data analysis. Only after this stage of had been reached did the various forms of data collection cease.

The inductively derived codes and themes were then related to extant literature and theory, first through a further step of conceptual coding using the categories of the coordination studies perspective identified in the Literature Review (see Table 4), and then creative reasoning to develop theoretical insights (see section *4.4* for details).

Abductive analysis emphasises a pragmatic process of explaining cases through creative reasoning. In contrast to deduction and induction, the abductive approach has less well-developed methodological guidelines (Timmermans & Tavory, 2012). Unlike deduction there is no explicit process of using a selected theory to frame hypotheses, guide the analysis of data and the interpretation of the results. Unlike induction (as may be represented by grounded theory methodology or GTM) there are limited methodological guidelines in contrast to the detailed procedures suggested by Strauss and Corbin (1998) and adapted more or less strictly by the wider GTM community (Urquhart & Fernández, 2016; Wiesche, Jurisch, Yetton, & Krcmar, 2017).

In deduction, extant theory guides the research design, data collection and analysis. In induction a series of methodological guidelines are used to guide the movement between data and the concepts that are elaborated, based on the constant comparison between the two. This is a process of reasoning through identifying multiple, similar cases as the basis for refining higher level constructs.

Abduction is based on a process of reasoning that is logically distinct. Abduction generates new theory by building on unexpected findings, and suggests a plausible causal process either based on similar phenomena already described in other settings or in terms of novel theoretical description (Timmermans & Tavory, 2012). As a result abduction is less closely tied to theory (in the case of deduction) or to data (in the case of induction), and requires the identification of a plausible explanation from a range of possibilities. These possibilities first have to be identified, and then the most appropriate one selected. Without clear criteria or a rigorous process the validity of abductive analysis is open to criticism.

Timmermans and Tavory (2012) recommend an approach to abduction which is informed by a knowledge of various theories so that different possible explanation can be tested, compared and rejected where they fail to explain the findings of research. In their words, “in-depth knowledge of multiple theorizations is thus necessary both to find out what is missing or anomalous in an area of study and to stimulate insights about innovative or original theoretical contributions. Rather than engaging with the scholarly literature at the end of the research project, as inductivist approaches have often advised, abduction assumes extensive familiarity with existing theories at the outset and throughout every research step” (Timmermans and Tavory, 2012; p173).

Timmermans and Tavory (2012) further propose three clear methodological strategies to subject abductive analysis to tests that help ensure the rigour of the underlying reasoning. These strategies consist of revisiting the phenomenon, defamiliarisation and alternative casing.

Field study research reveals different aspects of a phenomenon as it is revisited. Returning to interview transcripts, field notes and photographs can lead to a different perspective on what was encountered in the field, leading to improved understanding (Tavory & Timmermans, 2014). When followed carefully this process foregrounds different aspects of the data, and leads to a different conceptualisation of the phenomenon and consequent theoretical understanding over time.

Defamiliarisation adds to revisiting the phenomenon over time as a process of making the familiar unfamiliar. A primary means of defamiliarisation is the reading and rereading of accounts of field work, and the analysis of this experience. The writing of this experience structures it in a certain way, but the reading and rereading of this account opens the reader to other possible understandings by foregrounding the artificiality of the structuring necessary to develop a coherent account.

Alternative casing draws on both of these previous techniques, and brings the results into conversation with existing theories. Different theories present different possible ways to understand a phenomenon. The understandings and insights offered by different theories need to be tested against what is known of the phenomenon to ensure that valid explanations are not discarded without being properly evaluated in the process of theory development. Accordingly alternative casing involves attempting to explain findings using a variety of theories. Only once a range of plausible theories have been tested against findings can they be discarded in favour of the development of novel theoretical explanation.

4.3 **Data Collection**

Data collection followed an iterative process as recommended for qualitative studies (Charmaz, 2014; Walsham, 2006). This permitted the research focus and data collection to shift in-process to explore issues raised by informants. Rigidly following a predetermined theoretical framing, suggest Dyer and Wilkins (1991), risks ruling out such responsive flexibility (see section 4.3.2).

The schematic in Figure 2 below summarises the process of data collection at a high level, and how it was refined over the course of carrying out the field work.

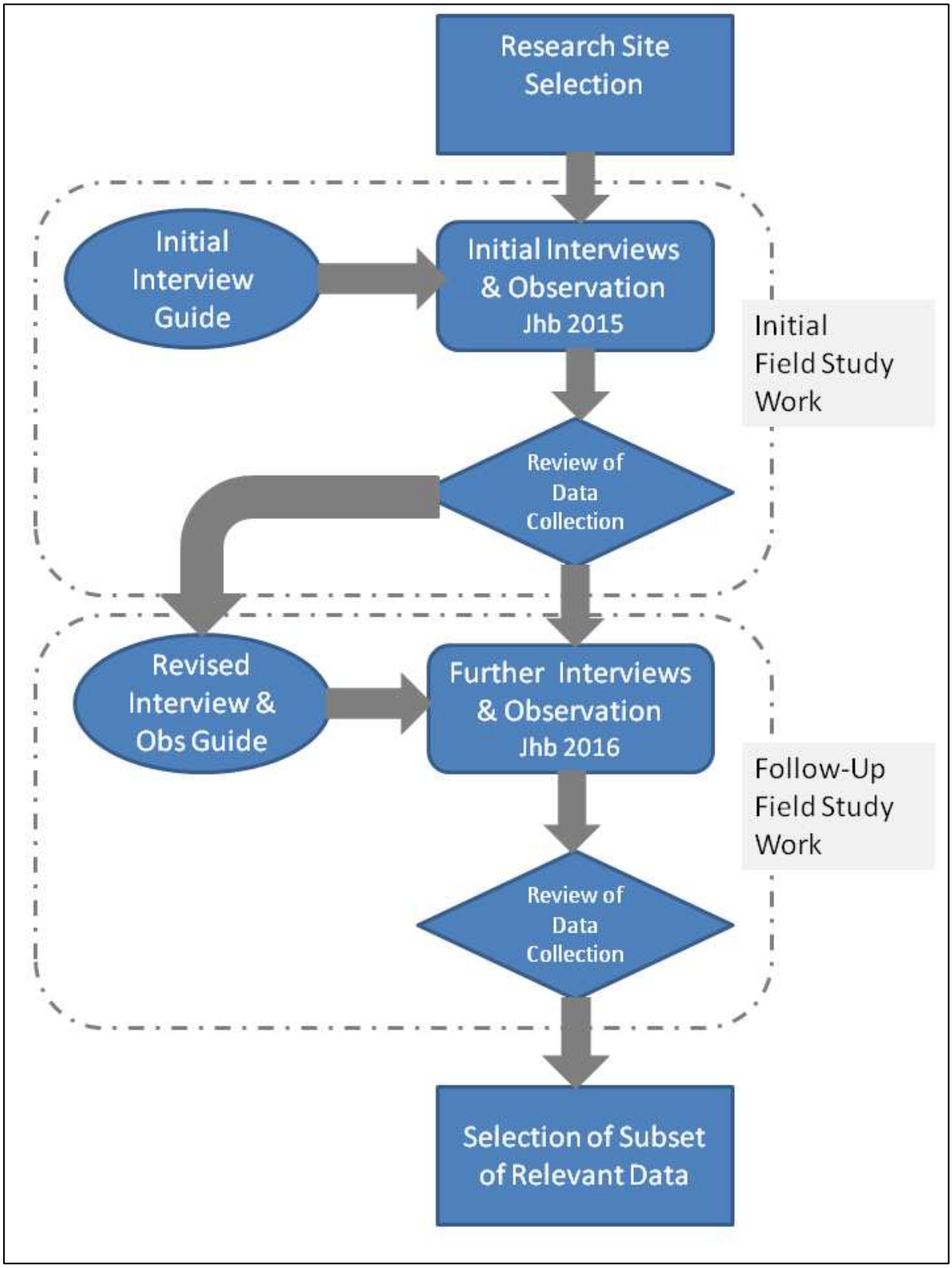


Figure 2 Schematic Diagram Summarising the Process of Field Work at a High Level

Three clinics were finally selected for the purposes of this case study. All are situated in the inner city of Johannesburg, and have a longstanding relationship with the nearby University of the

Witwatersrand. This association goes back to the early stages of research on the HIV/AIDS epidemic (Palitza et al., 2010). The selected clinics were thus accustomed to the presence of researchers from academic backgrounds (such as medical students) making them suitable sites to study the coordination of the MomConnect service: their routines were unlikely to be disrupted substantially by the researcher's presence. The association of the selected clinics with a research institution also meant that trying out new techniques and technologies (such as MomConnect) was a familiar process. Further, the selected clinics had previously participated in the MAMA project (Mobile Alliance for Maternal Action, 2014), a donor-funded research initiative that had inspired the development of the MomConnect service.

The first round of fieldwork was conducted starting in January 2015. Facility managers were first approached for permission to perform research in their clinics, with the purpose of the research fully explained in these meetings. All granted permission. Following this, on-the-record interviews were conducted with each facility manager. The managers then recommended staff interviewees who could follow up on issues in more detail. All these referred members of staff, with the exception of one ANC nurse, were willing to give interviews. However, another ANC nurse at the same clinic agreed to speak on the record during a subsequent clinic visit.

4.3.1 Ethical Provisions

Permission for the research was obtained from the Human Research Ethics Committee (HREC) of the Faculty of Health Sciences, at the University of Cape Town (HREC reference number 876 / 2015). Permissions were sought at both relevant organisational levels, and from individuals, for interviews, follow-ups and observations, with written consent being obtained before each interview. The transcripts were anonymised, using a series of codes corresponding to the informants' names. This table of corresponding codes and names was held in a password-protected spreadsheet.

4.3.2 Interviews

Qualitative interviews (Weiss, 1995) were conducted with clinic managers, the ANC professional health staff at the clinics and support staff performing MomConnect registrations in the course of their daily work. These initial interviews were guided by general questions based on established IS principles, engaging with technology features as well as the research setting (Kaptelinin, Nardi, & Macaulay, 1999), and the functionality identified for MomConnect. For a detailed account of these initial questions, see the interview guide in Appendix B.1. When informants expressed an interest or concern not covered in the guiding questions this was explored in an open-ended format. The interviews were recorded, and transcribed.

Open-ended interviews (Rapley & Antaki, 1998; Rapley, 2001) were used rather than structured interviews, to capture information that may not be perceived as important by the informants, because actual work practice is often not accurately reported in complex collaborative work (Wears & Berg, 2005). For the same reason, observations were also conducted and used to cross-check the results of the interviews, exploring and comparing discrepancies (see section 4.3.2 below).

The interviews were conducted in English as this is a commonly spoken language in government service environments such as public health clinics, and all of the clinic staff were confident and able to communicate effectively using it. It is also the home language of this researcher. Not being able to speak indigenous languages meant that this researcher was unable to follow approximately half of the informal exchanges that took place between staff. However the proficiency of the staff in English meant that this was not an obstacle in interviews.

The recordings of the interviews were sent to a professional agency for transcription in English. The transcriptions were spot-checked against the audio recordings for general quality control, and corrected if words had been rendered incorrectly. Later analysis of the transcripts also proceeded in English.

During interviews informants were asked whether they were willing to take part in follow-up interviews to discuss issues that might need clarification or further exploration. Everyone who agreed to be interviewed initially was willing to do this. In practice however, some informants had left their facility before follow-ups could be arranged and so were no longer available. In these cases, the new incumbent of their role was interviewed in their place.

The number of interviews (summarised by staff member level) is presented in Table 8 below.

Interviews	Staff Level		
	Clinic Managers	ANC Nurses	Health Intermediaries
No of Interviews (2015)	4	3	6
No of Interviews (2016)	3	4	3
Total Individuals Interviewed	3	6	7
Individuals interviewed in both 2015 and 2016	3	1	2

Table 8 Summary of Interviews Conducted by Role (Researcher's Data)

The initial set of questions posed to the nurses and support staff around the integration of MomConnect in the workplace were based on the IS principles outlined above (Kaptelinin, Nardi, & Macaulay, *op. cit*.). These questions are presented in Appendix B.1.

These initial questions were focussed on MomConnect registration process, the people and resources involved in this, and the obstacles that needed to be overcome. However, informants often directed conversations to concerns and topics with no direct relationship to MomConnect. These concerns often related to the relationships between staff and clients, clinic management issues outside of the ANC and influences from the cultural-historical setting. The informants were encouraged to clarify these concerns if there was overlap with issues identified previously. A preliminary review of the data was carried out during the first round of field work. Issues that arose at one or more clinics were flagged for later probing at other sites, particularly where issues related to one of the elements of the coordination studies perspective, or carried particular emotional load for the informant. This approach was used to guide the second round of interviews, to clarify the significance of these issues, help locate them in the deductive analysis, or flag as an unexpected finding for later analysis.

The interpretive research design of this study enabled the initial interview questions to be refocused to explore other issues whose relevance to the research only became apparent later. This also led to a realisation that the planned focussed observation sessions needed to be supplemented with general observation. Accordingly, an expanded role for observation was identified, as discussed below.

4.3.3 Observation

Observation was chosen as a less demanding and non-intrusive way (for the staff) to gain additional understanding. Observation of staff interactions with pregnant women who were being informed about MomConnect had taken place at the time of the initial interviews in 2015. Further interviews of staff interactions, as well as general observation of clinic routines, emerged as useful additional ways to help understand clinic coordination.

The facility managers were approached for, and granted, permission to extend observation to include more sessions of staff-client interaction on MomConnect registration, as well as general observation of clinic routines. Additional sessions of interaction were observed, and notes were made of the presentations within which introduction of MomConnect was embedded. (These were general presentations on self-care and the stages at which new development of the baby would become evident e.g. the mother feeling the movement of the baby inside the womb.)

The observation process entailed sitting in the waiting room as clients gathered in the morning, and moving to the ANC room to wait with the pregnant women for the presentation to begin. Field notes were taken during these sessions, following the format set out in Appendix B.2. Informal interactions with the informants also took place while spending time at the clinics, ranging from incidental comments while arranging interview times to spending ten minutes in the tearoom together. These exchanges sometimes provided insights that the informants did not state in formal interviews.

Focussed observation sessions were carried out at least three times for the MomConnect presentation / registration sessions; more often in the first round of field study in order to become more familiar with the clinic environment. Focussed observation sessions were supplemented by general observation periods. Over 40 hours were spent in each clinic taking notes on general clinic routines and being present in the environment. The number of observation periods is summarised in Table 9 following. The interview transcripts were supplemented by the field notes from these observation sessions.

At times, the observation activity involved the researcher assisting in the actual registration process, either after volunteering when the staff were particularly busy or, later, when they felt that it was appropriate. An offer to assist with filing was made at each clinic, to gain insight about unspoken negotiations and routine operations. Although these were never rejected outright by the clinic manager, the offers were never taken up. Nonetheless the researcher was seen as a resource in some sense, occasionally being drawn on in the registration process. This influenced the type of information that was volunteered in interviews, as well as the interactions that were visible.

Informal interactions – such as when a meeting time was being negotiated, or over a cup of tea – sometimes yielded particularly revealing information.

The researcher was thus necessarily implicated in the type of information it was possible to access (Charmaz, 2014). Not being medically trained or able to speak indigenous languages, and as an older white male, it was not feasible to be simply a participant observer. When requested to help present MomConnect to the pregnant women this researcher was careful to note up front my status as a student and not as a medical doctor, as was sometimes assumed.

4.3.4 Project Documentation and Other Sources

Publically available reporting and project documentation was also consulted. This included formal documentation of work practice in clinics, which included the recommendations of different registration pathways suggested by the design team (RMCH, 2014). In addition, websites were searched to locate project resource documents (Jembi Health Systems NPC, 2014; RMCH, 2015; South African Government News Agency, 2014a), as well as news reports (SABC Digital News, 2014a, 2014b). Some project stakeholders made presentations and other materials available to assist in the research. The opportunity also became available to informally observe a training session held with nurses early in the project.

The researcher attended symposia dealing with mHealth projects in South Africa (for example MEASURE Evaluation (2016)) to become familiar with the industry and current concerns (Barron, 2016). Informal interviews were held with some individuals encountered through this process. Published papers were also consulted (Barron et al., 2018; Barron, Pillay, Fernandes, Sebidi, & Allen, 2016).

The interviews and observations carried out at the different clinics as well as with other sources are summarised in Table 9 overleaf.

Clinic	Type	2014	2015			2016
			Jan-Apr	May-Aug	Sept-Dec	Jan-Apr
Clinic A	Interviews		Facility Manager (1) ANC Nurse (1) Health Int (2)	Health Int (1)	-	Facility Manager (1) ANC Nurse (1) Health Int (1)
	Observation			7		7
Clinic B	Interviews		Facility Manager (1) ANC Nurse (1) Health Int (1)	Health Int (1)	-	Facility Manager (1) ANC Nurse (2) Health Int (1)
	Observation		4	4		6
Clinic C	Interviews		Facility Manager (2) ANC Nurse (1) Health Int (1)		-	Facility Manager (1) ANC Nurse (1) Health Int (1)
	Observation		3	4		4
Additional Interviews*	MomConnect Technical Contractors	Informal Interviews (1)	Informal Interviews (2)	-	-	-
	Industry Experts	-	-	Informal Interviews (3)	-	-
	WRHI Field Workers (MAMA)	Informal Interviews (1)	-	-	-	-

* Not formally analysed

Table 9 Summary of Interviews and Observation carried out in the course of the Field Work (Researcher's Data)

4.3.5 Particular Challenges of the Case Setting

The case setting posed multiple logistical challenges. Scheduling appointments with the staff was often difficult. Email was an unreliable way of making contact or confirming meetings even in the case of clinic managers, because of overfull inboxes that had lower priority than attending to immediate clinic needs. The clinic managers gave their cell phone numbers as a preferred contact route. However in practice, while cell phones were more reliable, they were often not carried as clinic managers attended to urgent matters in different areas of the clinic, or were simply not heard in noisy, crowded, confined clinic spaces.

Clinic managers were sometimes unavailable at scheduled times because of management meetings called since the arrangements had been made, or staff shortages obliging them to deliver care to clients themselves. One clinic manager, for example, was occupied dispensing chronic ARV medication to outpatients at a time when a meeting had been agreed. For the manager, dispensing the medication was the priority: the clients' HIV symptoms were controlled and so they were likely to leave the clinic without medication if they had to wait too long, because they needed to get back to work.

Interviews often had to be rescheduled two or even three times after I had already arrived at the clinic. When no other interviews or observation were scheduled for that day I would sometimes use the time thus freed up for observation or to make informal contact with other informants and stay in touch with their sense of how things were going in the clinics, outside the potentially constraining situation of a recorded interview.

Clinic staff also cited challenges that were less predictable – for example one facility manager was unavailable because of the need to supervise repairs to the clinic's electrical wiring.

4.4 **Abductive Analysis**

This section explains how the abductive approach (Timmermans & Tavory, 2012) taken to the data analysis and theory development builds on the interpretive case study to provide insight on the phenomenon of coordination of mHealth, and clarifies how this aligns with the rest of the methodology. The application of this approach is described in Chapter 5. Abduction recommends the use of theory as a guide to designing research and data collection (Timmermans & Tavory, 2012). Unexpected findings are used to prompt the extension and possible development of theory through engagement both with the data and extant theory (Sarker et al., 2018).

The aim of the research was to understand the perspectives and experiences of the clinic staff, and how they integrated MomConnect registration into their daily routines. As noted in 4.3.2 the initial interviews used a set of guiding questions as a basis to explore respondents' perspectives and priorities (presented in Appendix B alongside the observation protocol for general observation sessions).

The transcripts of the interviews and the field notes were analysed in iterative phases (Charmaz, 2014). The transcripts were loaded into Atlas.ti ("Atlas.ti," 2015), and coded to support the analysis. A hybrid approach to coding (Saldaña, 2013) was used to accommodate the specific requirements of this research. This consisted of a combination of initial descriptive and thematic coding, followed by conceptual coding of the data based on the themes suggested by the coordination studies perspective. Finally an abductive process was followed to extend theory by interrogating unexpected findings, through revisiting extant literature and theory, and engaging in a creative reasoning process (Timmermans & Tavory, 2012).

4.4.1 Descriptive and Thematic Coding

Descriptive coding (Saldaña, 2013) was used in the first round to identify the different topics raised in the interviews at a granular level. The interview questions were aimed at identifying perceptions of MomConnect and the coordination mechanisms that were being used in the registration process. As noted in section 4.3.2, informants often responded by also discussing other concerns at length. Descriptive coding thus provided a way to identify recurring themes and a basis for identifying themes at a higher level of abstraction, while not omitting data that might later be identified as useful.

In many cases these concerns and observations related to general conditions of work or everyday issues encountered with clients, rather than with MomConnect registration. Sample codes with descriptions are shown in Table 10 below, and illustrate this. Where relevant the codes are related to aspects of coordination.

Sample Code	Description
ClientSubterfuge	Clients visiting one clinic and then another, and not informing the staff so that multiple files are opened across different clinics. Typically described by the staff as a response to the diagnosis of a stigmatised condition such as HIV/AIDS or another Sexually Transmitted Infection (STI). This complicates artefact-based coordination that assumes a readily available client file.
ConvincingMothers	The importance of finding ways to encourage or use an emotional charge to obtain compliance from mothers. Particularly in regard to avoiding STIs, or transmitting HIV/AIDS to their child. This colours the relationships that nurses and health intermediaries establish with clients.
HIVAIDSStigma	Comments on the extent of implications of the stigma of HIV/AIDS, particularly for women. Examples such as women being unable to take their medication at a regular time as required to be effective, in order to avoid being seen by their partner.
InterFacilityMeetings	Descriptions of how and when members of different clinics meet. Clinic managers meet monthly at district meetings. Health Promoters meet outside of formal clinic arrangements with peers from other clinics. This is a way in which clinic staff coordinate and establish accountability to one another.
MomConnectFeedback	Feedback from district management (formal) or mothers (informal) related to MomConnect use. This potentially affects existing forms of accountability, which in turn can affect coordination in the clinic.
Outreach	Descriptions of outreach activities or desire for such activities. This was later identified as relevant to the integrative concept of accountability. See section 5.3.6.3 for more details.
UnderlyingConditions	Descriptions of clients who request attention for one symptom, but turn out to have another masked condition e.g. mouth sores and STIs

Table 10 Sample of the Initial Codes Developed (Researcher's Data)

This initial round identified 145 codes. An initial round of processing grouped these into families to identify clusters with internal coherence. In this first step, codes were sometimes assigned to multiple families, to avoid foreclosing association between codes too early. The full set of these codes and their assigned code families are available in Appendix C. These codes and code families were then reviewed iteratively, and some were discarded.

Discarded codes fell into three categories: codes related to the general cultural-historical setting but with little relationship to coordination at the clinic as related to mHealth; codes related to clinical details of health services rendered to clients; and codes of practical concern to staff but which are peripheral to coordination. Examples of discarded codes in each of these categories are discussed below.

South Africa experiences multiple health-related challenges, with maternal health of particular concern to the ANC nurses and health intermediaries interviewed. However, these broad concerns are tangential to the coordination of mHealth at the clinic. Examples of discarded codes for these general issues include HIVAIDStigma, MothersPregnancySocialPressure and CulturalChallenges (informants' opinions of specific language group's attitudes to health care). HIV/AIDS is an important and ongoing public health concern in South Africa and is of major practical importance in the day-to-day operation of the clinic. Thus mention of clinical issues of screening and treatment occurred repeatedly in the transcripts. Although multiple codes were created for these parts of the transcripts, the researcher's process of familiarisation with the clinic setting and mHealth made it clear that these codes did not add useful information on the coordination of mHealth, despite the importance of the topic to the informants. Codes such as HIVAIDSInitiation, HIVAIDSInitiationThresholds and HIVAIDSStaging were thus discarded.

Finally, several practical clinical issues were mentioned that were not relevant to clinic coordination and mHealth. Codes such as Misdiagnosis, MothersPregnanacyRisks, STIs and UnderlyingConditions were discarded for this reason.

This process of winnowing the initial descriptive codes was followed by a round of thematic coding (Fereday, Adelaide, & Muir-Cochrane, 2006; Saldaña, 2013). Further reflection on the data and field notes lead to the development of provisional higher-level themes (see Table 11 below), and the code families were each allocated to one of these themes. These higher-level themes related to high-level aspects of coordination that emerged from the data set. These were particularly useful because they enabled the data set to be rapidly revisited for future recoding because of the common-sense nature of the groupings.

No	Theme	Description	Relevance
1	Clinic Characterisation	Clinic setting and general conditions	Workplace setting of coordination
2	Clinic Work Practices	General clinic and ANC work practices	Work practices as the site of established coordination
3	Clients	Characteristics and behaviour of clients	Important aspect of relationships in work practices
4	MomConnect	Issues and practices directly related to MomConnect	Registration through and coordination of MomConnect
5	Tensions and Breakdowns	Conflicting demands such as allocation of staff when they are not all available. Leads to trade-offs at times.	Challenges to coordination
6	External Relationships and Reporting	Relationships and arrangements that span between clinics or between clinics and other organisations e.g. staff meetings, hospitals, district management	Lead to coordination beyond the boundaries of the clinic structure

Table 11 Themes Developed (Researcher's Data)

4.4.2 Deductive Coding and Data Presentation Formats

The coding above described the data at a relatively low level of abstraction, but provided a common-sense organisation that could readily be navigated for the purposes of recoding. Recoding was subsequently performed; taking the low-level descriptive codes identified in 4.4.1 and grouping them according to the categories of coordination identified in Table 3. In other words, deductive coding was performed matching the data to the coordination studies perspective (Fereday et al., 2006; Saldaña, 2013) as illustrated in Table 12 below. Some of the low-level codes were not used in this phase of the analysis. They were however retained because of their function in defining the provisional themes.

Table 4 in the Literature Review (see section 3.3.3) proposed a particularised format for classifying health care workplace mechanisms from the coordination studies perspective. Because the routine is a well-established entry point to understanding the coordination of IS, a matrix format (Miles et al., 2014) is used to present the data obtained from the field study, building on the work of the scholars who employ routines to understand the coordination of IS in organisations (Goh et al., 2011; Leonardi, 2011; Pentland & Feldman, 2008). This facilitates understanding of mHealth coordination as a series of steps in a routine, drawing on different mechanisms over time. Table 12 below illustrates the matrix format used in the Case Analysis.

Coordination Mechanisms for Routine Phases		**Routine Phase**		
		Phase 1	**Phase 2**	**Phase 3**
Example Routine	**Social**	Plans and Rules: Roles: Proximity:	Plans and Rules: Roles: Proximity:	Plans and Rules Roles Proximity
	Relationships			
	Artefacts			

Table 12 Routines as an Entry Point to Analyse Coordination (based on Table 4)

The deductive coding enabled the data set to be analysed according to the mechanisms of coordination: social (plans and rules, roles etc.), artefact-based (files, pregnancy wheels etc) and relationship-based coordination. This was used to respond to the first research question: "what are the coordination mechanisms evident in mHealth in the workplace". These higher-order code families were thus based on existing knowledge (Saldaña, 2013). This coding approach thus could not enable analysis of the transcripts beyond the point of existing knowledge (Sarker, Xiao, & Beaulieu, 2013).

The thematic coding describing the clinic- and broader cultural-historical setting was then reviewed in relation to the coordination mechanisms that had been identified, and the relevant transcripts were revisited. A process of review and reflection relating these elements of the transcripts to the mechanisms that had been identified was followed (the principle of the hermeneutic circle, see Table 5), and integrated with reflection on the relevant literature on the setting in order to address the second research question: "How does the workplace- and broader cultural-historical setting affect this coordination".

Finally the results of these first two cycles of analysis were synthesised to answer the third research question: “how does this influence the coordination routines that develop”?

The process of carrying out the interviews and conducting observation led to the emergence of concerns and issues raised by the informants that could not readily be related to the formal mechanisms of coordination that were used in the deductive analysis. Some of these issues were raised repeatedly by different informants, and prompted further analysis in order to explain these unexpected findings.

An iterative process was followed of reflecting on the raw data (transcripts and field notes), the thematically coded data and the deductively coded data (following the principle of the hermeneutic circle).

4.4.3 Abductive Theoretical Extension

Because as noted above some aspects of coordination associated with MomConnect registration could not be analysed using a coding schema based on existing concepts, a further iterative process of reflection was carried out on the conceptual codes (Charmaz, 2014). This process related them to the portions of the transcripts that could not be satisfactorily interpreted using existing categories (Andrade, 2009; Charmaz, 2014; Sarker et al., 2018). This process of reflection and recoding led to the identification of processes and conceptual categories foregrounding aspects of coordination specific to mHealth in the workplace and not described in extant literature (Timmermans & Tavory, 2012). These were used to extend the coordination studies perspective for mHealth in the setting of resource-constrained frontline workplaces, through a process of abduction.

These concepts and categories were tested by returning to the data, in some cases by probing with informants, and through returning to the literature to explore whether they held up to scrutiny (Sarker et al., 2018). In this way data-lead induction was combined with theoretical insights from existing literature. Creative reasoning (Behfar & Okhuysen, 2018; Timmermans & Tavory, 2012) was then used to develop the major theoretical contribution of this research, namely the identification of novel coordination mechanisms and the problematisation (Alvesson & Kärreman, 2007; Gkeredakis & Constantinides, 2019) of the coordination studies perspective in use (see section 5.3.5.6 for details).

Figure 3 below shows the relationships of the different steps in the coding process. It provides a schematic overview of how inductive and deductive coding processes (resulting in thematic and conceptually coded data respectively) were developed from the same set of descriptive codes. The themes and mechanisms identified in this way were compared and related to each other in the

process of analysing the coordination of MomConnect registration. Unexpected findings that could not be resolved through this iteration (the Principle of the Hermeneutic Circle) were analysed through a return to the literature and extant theory, supporting a process of rigorous conceptual reasoning and theoretical development.

Chapter 5 (following) details the case analysis, highlighting the coordination mechanisms involved in coordination MomConnect registration at each clinic. The comparison of the different clinic cases brings to the fore the unexplained findings that accumulated in the course of the field work. This is followed by the core theoretical contribution of this research, the identification of novel constructs emerging from the analysis of these findings.

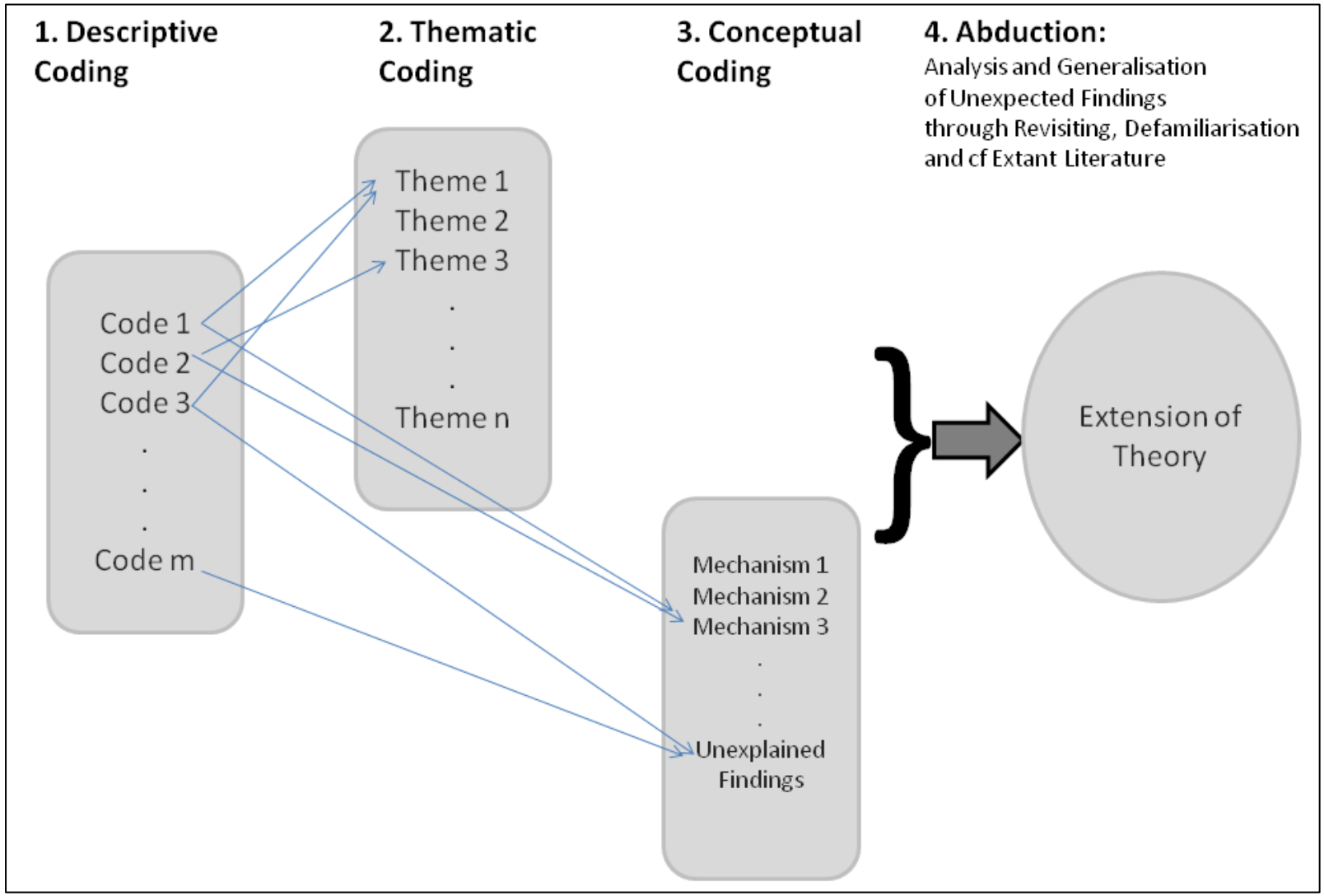


Figure 3 Coding and Theory Extension from the Field Work (Interview Transcripts and Field Notes)

Chapter 5 **CASE ANALYSIS**

This chapter recounts the observations and findings of the case study, employing the research questions and framing concepts presented in the Literature Review to guide its analysis. The first section provides a narrative detailing the specifics of the case setting. Following an abductive approach, the second section analyses the case using the elements of coordination that were identified in the Literature Review as being particularly relevant to healthcare workplaces.

This analysis reveals three novel concepts, not directly derivable from the literature review and the coordination studies perspective; these concepts form the pillars of the research contribution. They are identified via an abductive analysis that juxtaposes the evidence for their operation and the literature and is grounded in the integrating conditions identified by Okhuysen and Bechky (2009). The chapter concludes with a second narrative section engaging with issues highlighted in the analysis.

Because, as noted in Chapter Four, this research adopts the interpretive paradigm, commitment to reflexive research requires reporting that does not position this account as a detached "view from nowhere" (Nagel, 1989), but rather supports conveying the "fullness of fieldwork phenomena" (Charmaz & Mitchell, 1996:287) in line with the Principle of Interaction (Klein and Myers, 1999). The case analysis is thus "bookended" by the researcher's first person accounts to convey more clearly the context of the fieldwork (Principle of Contextualisation) (*ibid*.), and the process of doing this research as a person with a specific identity and history working in a specific country setting (Reflexivity as an extension of the Principle of Interaction) (*ibid*.). This is reinforced by quotations from interviews and details of informal interactions at the three urban clinics in Johannesburg.

5.1 **Prelude**

I drive to the Rosebank Gautrain (high speed rail) station, board, and ride south into the centre of town. Arriving at my destination, I exit the station with a throng of other commuters. Most, wearing formal office outfits, are heading for the PRASA (Passenger Rail of South Africa) head office building, just over the street. I turn left towards the clinic, and soon I'm the only "white" person that I see.

Queues of people are waiting for minibus taxis: the informal transport network that ferries most low-income travellers around town. Above, on the balconies of run-down blocks of flats, washing is strung out to dry, like a section of Naples I once saw. Workmen are busy fixing the pavement; I'm often forced to step into the road, dodging oncoming traffic and picking my way through the puddles from broken drains.

Soon, I enter the park, past the street vendor selling cigarettes and snacks. Men play chess on two giant boards painted on the concrete, with close to a score of spectators commenting on the progress of the game. To the left, past the pre-primary school painted in bright colours, my path leads to the clinic behind its pointed palisade fence.

Figure 4 Chess Players in the Park (Researcher's photograph)

It's not yet 8 am, and the nurses are still busy opening up. I greet the security guard at the gate and find an unoccupied seat outside. A lay preacher I recognise from earlier visits is leading the gathered clients in prayer and song. I've no idea to what extent people feel any affinity for her, but since there seems to be general participation I bow my head in respect. The clinic manager walks past to speak to staff outside and nods to the preacher as she passes; there must be some implicit or explicit understanding of what is acceptable use of this public space. At another clinic, I've also seen occasional morning prayers. Those were in the South African languages I don't speak, so I caught only a few words. This is in English, with a hint of North American inflection; I imagine the lay preacher may be from another African country further north.

When the service is done I go into the clinic, greeting staff with a cheery "Good day, how are you?" I ask whether my informant is there today; we had arranged that I should conduct an interview. "No, he is sick today". I spend the morning observing the general clinic routine instead, making notes in my notebook, and reading on my phone when times are quiet. At lunchtime, I walk back to the station to buy some coffee, eating my sandwiches as I walk round the park, heading back to the clinic.

5.2 **Case Setting**

5.2.1 Project Details and Physical Setting

This section expands the overview of the MomConnect project presented in the Introduction, focusing on details of the registration process and the use cases proposed in the training material. Subsequently, the clinics and their organisation are described, highlighting the general priorities and concerns noted by the staff during the open-ended interviews, which, as noted in Chapter Four, were adapted to probe issues emerging during the research. This description is organised around the inductively-derived themes derived from the descriptive coding described in the Methodology (see section 4.4.1).

The MomConnect mHealth service was initiated in South Africa in August 2014 (South African Government News Agency, 2014a). MomConnect is a free text messaging service (Barron, 2016). It provides informative messages to pregnant women, and mothers until their babies reach one year old, to help them look after their own and their children's health. It also offers a facility for mothers to report on their satisfaction with clinic services and ask questions to a central team – supervised by a professional nurse – at the national department of health (NDoH) (Xiong, Kamunyori, & Sebidi, 2018).

Nearly 900 000 women were registered on MomConnect in its first two years of operation, and over 200 000 routine questions were answered in this period (Barron, 2016). A telephonic survey in July 2015 indicated that over 98% felt that MomConnect had helped them, and over 80% had shared the messages with friends or partners (op cit.).

Both health intermediaries and pregnant women themselves can register for MomConnect via their phones. However, a full set of messages only becomes available if the woman is personally registered at a clinic; for all other kinds of registration only a subset of the messages is made available. The clinic staff are involved only peripherally in system use, but they are gatekeepers of access to the service. Demographic and clinical information for registered mothers is securely transferred to the National Pregnancy Register of the Department of Health: a core component of the MomConnect project. The implementing agent for this part of the service can provide monthly reports on the numbers of mothers registered by clinic to National Department of Health managers (Jembi Health Systems NPC, 2014), and, via the provinces, to Health District and clinic managers.

Prior to the MomConnect project, most reporting from the clinic took the form of monthly paper reports (Garrib et al., 2008), and reached the national department only after being reviewed by the

provincial department (Hanmer, 1999). MomConnect thus allows national officials access to MomConnect registration figures well before the rest of the clinic statistics.

The MomConnect mHealth service uses the Unstructured Supplementary Service Data (USSD)[4] protocol to register users. This involved entering a standard code to start the registration process. To complete the registration, several data items are required, starting with the registree's phone number for SMS message delivery and the unique clinic code. Registration is finalised by entering the baby's expected date of delivery (EDD) and the woman's passport or identity document number; after this she will start receiving biweekly messages.

Table 13 below summarises the major functionality that MomConnect offers to end users, namely health managers, clinic staff and pregnant women or mothers of young children.

User Group	Main Functionality	Description
Health Managers	Reporting	Monthly reports on registration numbers per clinic Ability to address women's queries via the Question Line Feedback loop to clinics (via District Management) on Compliments and Complaints
Clinic Staff	Registration	Registration of Pregnant Women
Pregnant Women	Health Information and Questions	Provision of Health-Related Information by SMS Free Question Line Compliments and Complaints Line

Table 13 Summary of MomConnect Functionality for End Users (based on Barron (2016))

This is the first time this kind of service has been rolled out at national level in South Africa and implementing MomConnect provides end users with rather more than the specific functionalities described above. It also establishes lines of communication that did not previously exist, or had existed only in a less structured form. Health managers at national level previously had to wait for local paper reports to be collated at district and provincial level before they could access information about clinic-level activities. MomConnect makes this a rapid process based on collating registrations

[4] Unstructured Supplementary Service Data (USSD) is a protocol used by GSM cellular telephones to communicate with the service provider's computers. USSD messages are up to 182 alphanumeric characters in length. Unlike Short Message Service (SMS) messages, USSD messages create a real-time connection during a USSD session. The connection remains open, allowing a two-way exchange of a sequence of data. This makes USSD more responsive than services employing SMS ("Unstructured Supplementary Service Data - Wikipedia, the free encyclopedia," n.d.)

received at the NPR. Pregnant women can send questions directly and privately to the call centre at the NDoH, and obtain advice directly from the centre. Clinic managers can receive feedback via the District office on the number of registrations, or the compliments and complaints submitted by the mothers.

The MomConnect service relies on a technical infrastructure that may be conceptualised in terms of layers of services and is illustrated in Figure 5 below. Clinic staff and pregnant women interact with the system via mobile handsets (termed the "device layer" in the diagram). The "service layer" accepts registration requests and provides messaging services. The "registry layer" provides routine reporting to health managers. All these layers are supported by a "security services layer", to ensure the confidentiality of the personal information being transferred (Jembi Health Systems NPC, 2014).

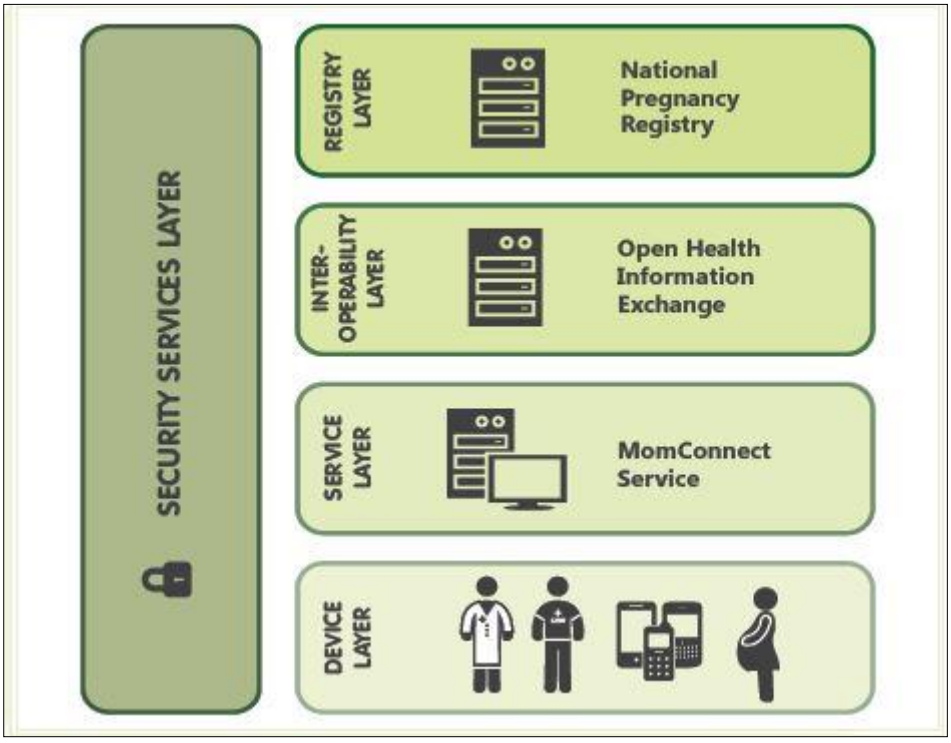


Figure 5 MomConnect Infrastructure Overview (Jembi, 2014)

The "device layer" and "services layer" are connected via the infrastructure of the mobile network providers in South Africa. Requests received via the different providers by the "service layer" are integrated into a single stream, so that subscribers to different networks receive a uniform service. Clinic staff and pregnant women interact with the service via USSD and text messaging services with which they are familiar from their routine use of mobile network services. An open-source framework was used to implement the MomConnect infrastructure shown above, to ensure standards compliance and interoperability with other eHealth services ("OpenHIE," n.d.).

The MomConnect registration process operates at the "device layer" and is represented schematically in Figure 6 below.

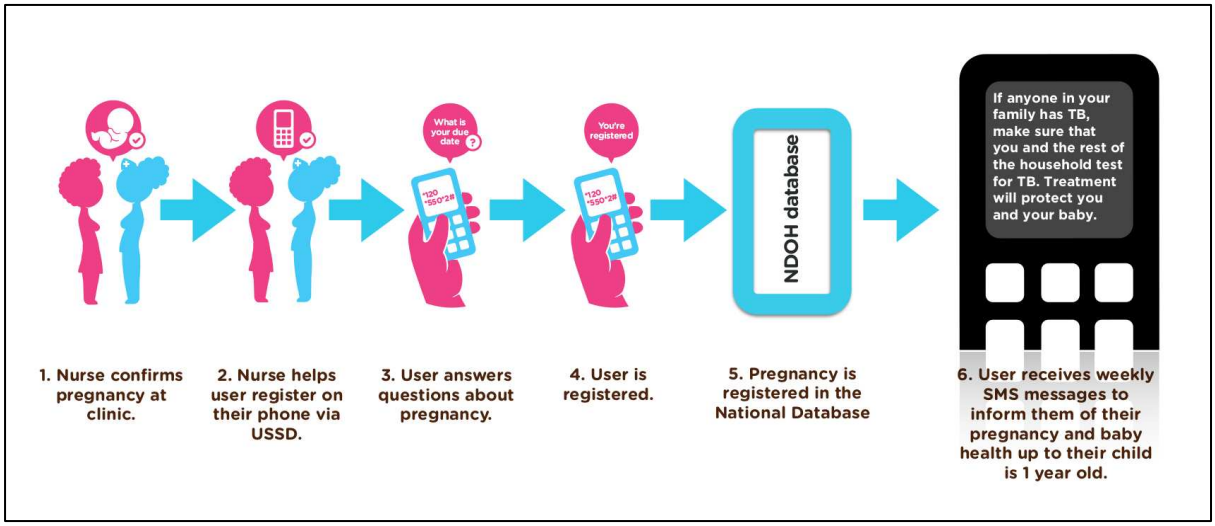


Figure 6 Overview of the MomConnect Registration Process (National Department of Health: Republic of South Africa, 2015c)

The steps are described in more detail in Table 14 below.

No	Step	Details
1	Enter the USSD sequence to start MomConnect registration process	*134*550*2#
2	Respond to the prompt with the number to which messages should be delivered	Defaults to that of the handset in use, otherwise may be specified separately if done on behalf of another
3	Enter the clinic code	Unique for each clinic so that every registration can be related to the physical facility
4	Enter the month and day when the baby is due	Identified by the nurse from examination of the pregnant woman (known as the Estimated Due Date in the clinic)
5	Enter the type of identification brought by the pregnant woman	May be a South African Identity Document, Passport or None.
6	Enter the identification number or passport number.	Where there is neither, enter the month and day of birth of the woman.
7	Select the language that the woman would prefer to receive text messages in	All eleven official languages were available on MomConnect by the end of 2015
8	Message confirming the registration is returned	

Table 14 The MomConnect Registration Process Steps (based on National Department of Health (2014))

Many phones owned by pregnant women in rural South Africa are not capable of connecting to the internet. The MomConnect project was intended to provide the most extensive coverage possible, and to cater to the needs of all clients, and the USSD protocol was thus used instead of an internet-

enabled application. Figure 7 shows a typical low-end handset such as those owned by low-income mothers.

Figure 7 Example of a Typical Low-End Phone used in Registration (Researcher's photograph)

Different clinics have different established work routines in their ANC sections, and also differ in the number and kinds of health intermediaries available to assist ANC nurses. For this reason, MomConnect created training materials suggesting multiple routines for how registration could be incorporated into existing work practices at clinics (RMCH, 2014). The routines for MomConnect registration presented to nurses in the training sessions are laid out in Table 15 below.

Registration Routine	Description
Option 1	In this scenario, mothers are first gathered together for their health education classes. These will usually be run by Health Promoters. At this stage it would be good to start to educate the mothers about the MomConnect Project, what it is and how they will sign up. The mother will then go into her consultation with the nurse and when she is in her consultation, the nurse should ask whether the mother would like to sign up to MomConnect. The mother's choice to sign up or not sign up should be recorded on her file by the nurse along with her EDD[5]. When the mother hands her file back to the Data Capturer, the Data Capturer will then register the mother through the *134*550*2# code if she has decided to join the programme.
Option 2	In this scenario, mothers are again gathered for their health education classes and at this point the Health Promoters educate the mothers about the MomConnect programme. However, once the consultation with the nurse is done, the file is left in the consultation room and the mother leaves the clinic without taking her file back to the Data Capturer. In this case the nurse should ask the mother if she wants to be part of the programme, and sign the mother up through the *134*550*2# code before she leaves the consultation. This should also be noted in the clinic file so that during future visits the mother is not asked to register again.
Option 3	If no health education classes are offered and there is therefore no opportunity to talk to the mothers as a group about the MomConnect programme, it is suggested that a clinic staff member is tasked with handing out the informational fliers to mothers while they wait for their consultation. Then, in their consultation, the nurses will need to talk to the mother about the programme. The nurse can then sign the mother up through the *134*550*2# code or a Data Capturer can do this when the mother returns her file.

Table 15 Suggested MomConnect Registration Routines (RMCH, 2014)

Thus far this section has described the MomConnect project, provided an overview of its functionality, set out details of the registration process and identified the suggested routines for incorporating registration into existing ANC workplace arrangements in alignment with the main research question. This provides a basis for analysing the mechanisms supporting the coordination actually carried out at the clinics.

All the case clinics are located in the inner-city of Johannesburg, ranging from the flatlands of the old Central Business District (CBD) to a conglomeration of residential, commercial and light industrial land use further from the centre of town. Figure 8 below shows a street in the CBD at a quiet time, with the road works that were ongoing at the time of the study.

[5] Expected Date of Delivery. See Figure 11 for details.

Figure 8 Quiet Johannesburg CBD Street Scene (Researcher's photograph)

The clinics have been titled Clinics A, B and C to preserve confidentiality. Their approximate locations are shown in Figure 9 below; their specific physical environments are as follows:

- Clinic A in the old Central Business District (CBD) in the red zone.
- Clinic B at the transition from the CBD to the inner suburbs in the green zone.
- Clinic C along an arterial road in the inner suburbs in the blue zone.

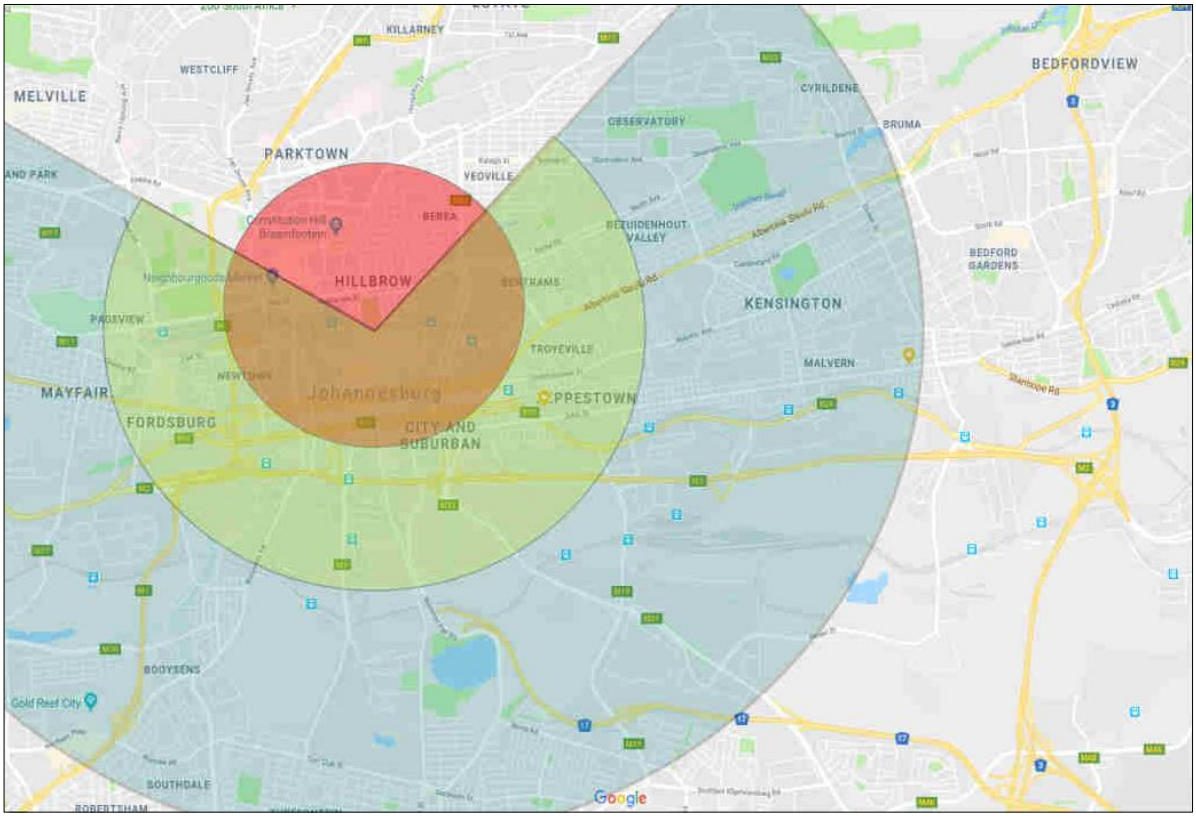


Figure 9 Zones showing the relative locations of the clinics (Researcher and Google Maps)

The staff at the clinics described a number of issues related to the physical clinic setting as well as local social conditions that impacted on the delivery of health care services and by extension, the delivery of ANC services of which MomConnect registration is a part.

The manager of Clinic A described the implications of the clinic location as follows:

"... the reason why it's busy, it's in the CBD (Central Business District) area, people are working here. (They stay) far away, ... in Soweto [an outlying residential area], or whatever. And then they work here. ... they come here whenever they feel like they want to be seen (at the clinic) and then go back to work again. ... And we've got so many flats … (in a) one room flat we find about three, four, five families. ... And then another contributing thing is … we've got a hospital (near) us." (Interview 7)

By contrast, a member of staff at Clinic C said that the clients attending there were not only from the surrounding residential areas but also worked at the businesses on the arterial road outside.

While the clinics were quite different to each other in their physical location, the coordination of their operations was very similar. Clerks at the entrance to the clinic recorded such details in large paper registers, as each client reached the front of the queue. Nurses did not have access to a computer terminal, and almost all recording of client data was done manually, using paper forms. The one exception was the data for clients on anti-retroviral therapy (ART). A data capture clerk in

each clinic had the main duty of capturing this information on the Tier.net desktop system (Chowles, 2014).

All case clinics had the following sections: ANC, chronic disease care (TB, HIV) and mother and child (under fives) health (see Table 1). Each section was the responsibility of a different nurse, who was responsible for dealing with all clients attending her section, with the assistance of student nurses when available, and other health intermediaries. If a section was busy, sometimes more than one nurse would be assigned to it.

Figure 10 below shows the registration desk at a clinic with filing shelves for the clients' folders in the background.

Figure 10 Registration Desk with Filing Shelves (Researcher's photograph)

5.2.2 Clinic Constraints

Resource availability was repeatedly identified by clinic managers as a key constraint they faced; with time one of the resources that was particularly scarce. One example is that cited in Chapter 4 Section 4.3.4, when a Clinic Manager at Clinic B felt obliged to take time away from her duties to counsel chronically ill patients (those with HIV and TB) lest they "became agitated" (Interview 19) with long waits and left before accessing their repeat medication because they did not feel unwell and feared returning late to work. The managers at Clinics A and C also stated that they would sometimes help out, but this was never observed during the field work.

Staff numbers were also identified as a constraint, and this was exacerbated by the tensions added when staff became unavailable for various reasons. At Clinic A, the manager stated that:

"Ja, because the thing is, when someone is sick, it's a problem because we don't have the relief staff. So if say somebody's sick or somebody is on leave or somebody has gone for a training. There's no relief staff. So I must take from one area to another area. So that each area is covered." (Interview 8)

And:

"You send them to (courses for training) at your own risk ... And if you do not send them ... you are also disadvantaged because you are having staff which (are) not well trained in all their consulting." (Interview 8)

Clinic managers thus often adopted a very hands-on management style, to the extent of standing in for nurses at times as outlined above, and even supervising the restoration of power to a section of the clinic. Clinic managers also had to report to the city health managers for their region; one occasion when they could meet their peers.

This meant that a theme emerging repeatedly from interviews was the need to ensure all units of the clinic were providing adequate care within the constraints of staff and other resources, and balancing resources across the clinic so that the most critical shortages were addressed. Clinic managers face chronic staff shortages, particularly of enrolled nurses (Daviaud, 2008). This means they need to trade-off staff allocation between the different sections of the clinic, and, by implication, some services receive less attention as a result.

In the words of the manager of Clinic B:

"... you pay Peter to rob John. That is how it works. If you do good today that means tomorrow you must do good somewhere (else); (and) leave the ANC. That is how we survive. If you try to be everything you cannot". (Interview 6)

And:

"I have (only) four counsellors ... And that is a challenge, I have two counsellors in one service, and then the remaining two I have overstretched them". (Interview 6)

And the manager at Clinic C:

"if say somebody's sick or ... on leave or ... has gone for ... training. There's no relief staff. So I must take from one area to another area, so that each area is covered (has enough staff)". (Interview 8)

One unexpected issue emerging was the wide diversity of both staff and their conditions of employment. At the time of the study, the Department of Health in the province was absorbing staff from local Non-Government Organisations (NGOs) that had to some extent duplicated government health services (Clarke, Dick, & Lewin, 2008). The national government's Expanded Public Works Programme (EPWP) (a job creation initiative for unskilled workers) was also being used to provide clinics with additional resources (Schneider et al., 2008). A third category was volunteers, who were paid a small stipend and often employed on a month-to-month basis (Schneider, Hlophe, & Van Rensburg, *ibid*).

At Clinic A:

" ...they decided to do away with the NGOs ... last year ... so they had to send (the former NGO health intermediaries) to the clinics because there's a lot of them (and) they were distributed to different clinics. To ... continue with the peer education and then tracing, education" (Interview 7)

And:

" (EPWP workers) are helping us with everything that we need help on. Taking the blood pressures, you know, the patients the vital signs, doing the urine testings, helping us with the medicine. ... I'm the one who is responsible for the medicine store only, so the other one he helps me to pack the boxes, unpack the medication". (Interview 7)

Finally, in addition to the former NGO staff and EPWP workers, there were also some Ward-Based Outreach Teams (WBOTs) (National Department of Health: Republic of South Africa, 2015b): teams associated with measures to increase PHC outreach into local communities. In interviews and informal discussions it appeared that many of these staff are not permanent employees, but receive (not always reliably paid) monthly stipends from government structures. This was cited as possibly impacting on the willingness of this category to take on time-consuming tasks over and above their existing duties (see also Zachariah et al., 2009).

Health intermediaries are drawn from a range of positions including health promoter, CHW, volunteer (on a small stipend) and WBOT member. These positions have different training requirements, and even where formal training is provided this training is often not certified (Mottiar & Lodge, 2018). In the case of volunteers and WBOT members, not only is the funding of their positions uncertain, but benefits are very limited. This concurs with the general situation of health intermediaries described in other developing countries (see Chapter 2).

As a result of these multiple staffing challenges, MomConnect registration is not simply a technical exercise. It takes place in a setting where coordination involves very different roles to those

identified in extant literature on this aspect of health care. The literature has identified that nurses have distinct and officially-defined roles and routines. However, health intermediaries other than health promoters still have little in the way of a defined role in clinics, despite the official start in 2011 of PHC re-engineering (Schneider et al., 2018).

5.2.3 Antenatal Care

The ANC unit is one of the specialised units found in each of the clinics under study. The ANC consulting rooms typically each contained a desk and chair for the nurse, a chair for the client, and an examination couch. Other equipment such as weighing scales usually stood outside the consulting rooms in a common area, because of space constraints. From their designated rooms, nurses examined clients and diagnosed health issues all morning, and sometimes well into the afternoon.

The antenatal care nurse attended to each client individually, to confirm the diagnosis of pregnancy and its approximate stage and estimate the EDD. This was done using a circular cardboard device called the Pregnancy Wheel (shown in Figure 11) that helped to calculate the EDD relative to the current stage of pregnancy.

Figure 11 Pregnancy Wheel (Goodwin, 2017)

When this was the pregnant mother's first visit to the clinic, the examination was followed by a series of baseline health tests that could take up much of the rest of the day.

" … with the ANC I have to do everything for the patient, starting from admission, do the bloods, testing, even health education, examining the patient and everything… "(Interview 2)

And:

" Yes we register them … here and then … have to do that antenatal chart that we are doing. And then if the patients is HIV active I have to initiate them (on ART), for instance today I have initiated this lady. And for initiation alone it can take us 30 minutes because you have to do the physical examinations... and explain (the importance of adherence to the treatment regime) … " (Interview 1)

One of the recurring concerns expressed by clinic managers and ANC staff was the late stage of pregnancy at which mothers tended to come for their first clinic visit:

The ANC nurse at Clinic B stated:

"we are ... worried if the patient comes very late (for a first clinic visit after becoming pregnant). Because others they come at nine months. You book the patient today, you take bloods. Before the results come the patient is already delivered." (Interview 5)

And:

"they are starting clinic very, very late you know: mothers come at six months or seven months so … it becomes quite difficult to do the re-testing(for HIV in time to identify whether measures to prevent transmission to the child are needed at birth)" (Interview 12)

In the first round of research interviews, the manager at Clinic C confirmed that this was seen as a problem there as well. At that point she noted that less than half of the mothers came for a first visits before the target period of 14 weeks. However, in the second round of research interviews she noted that the number of mothers seen before this benchmark date had increased by almost 20%.

The large numbers of clients requiring attention and the shortage of staff meant that nurses in particular were torn between attending to each client as rapidly as possible ("*pushing the queue*", (Interview 5)), and taking the time to ensure that no significant symptoms were missed during a consultation. Staff stresses, they noted, were intensified because some clients would not disclose prior diagnoses with HIV or a sexually transmitted infection (STI). As the ANC nurse at Clinic B said:

"They don't tell you, 'I think I have syphilis or an STI or I'm positive', they tell the sister (nurse) 'I just have chicken pox' ... And I treated her for chicken pox, (but) as I'm busy treating her, something says 'check'!" (Interview 5)

Another stressful client behaviour identified in a number of interviews was "shopping around" between clinics. This was related to an effort to avoid stigmatising diagnoses by nurse, in line with the suggestion made by Stadler, Scorgie, van der Straten and Saethre (2015). Again, as stated at Clinic B:

"they might come to me and say 'you know what, I have been to the clinic today and then I just did my HIV test and then they said I am negative' and then only to find when you go and do your test you are positive" (Interview 12)

Clinic and hospital staff have sometimes expressed less positive attitudes towards clients, stigmatising them as "irresponsible" or "lazy" (Walker & Gilson, 2004). This has been documented as one factor in abuses of power by nursing staff (Jewkes et al., 1998). Such abuses formed one motivation for the mHealth solution of MomConnect to allow pregnant women to rate the service they receive at clinics.

Staff at all three clinics identified late attendance by pregnant women at the clinic as the biggest challenge they faced. They also noted the same need to cover for each other that the clinic managers had identified from a management perspective, for example at Clinic B:

"If one sister that side who's doing midwife now, like now she's pregnant, she's off sick. One of us must go and work (there). If I'm working there I'm seeing sixty or seventy patients, instead of thirty five." (Interview 5)

In addition, the nurses identified several issues emerging from relating to clients, including a need to persuade them to understand the seriousness of disclosing their medical status (for example, STI or HIV), as well as evasive behaviours displayed by clients in response such as moving between different clinics.

Lipsky (2010) has documented frontline public service staff managing the pressure of their work environment by adopting management strategies that maintain their authority in the face of demands for service. One theme emerging from this research was how the future wellbeing of the baby was employed to persuade pregnant women to be compliant. The ANC nurse at Clinic C reported:

"No mother wants the baby to be positive. So ... you don't want to explain to your baby, when the baby turns 5 or 11 asks mum why am I taking this treatment? ... Because in the beginning you say its vitamins but now as the child grows up later they will ask you "But mamma I'm OK now". So it's stressful to explain to your child, I didn't protect you when I was pregnant. ... So when we tell them that they just jump" (Interview 1)

And:

"You know when you tell them your baby is born and you have this discharges on the eye, that is syphilis, it means you have not been treated well and your baby is going to get injections as well, so

they don't want that part. Because they know that the injections we are giving them is very painful. So if she knows that this injections going to be given to the baby this is when they start to comply" (Interview 1)

This resonates not only with the findings of research on the coping mechanisms employed by staff involved in public service delivery (Lipsky, *ibid.*), but with more recent investigations of choices to disclose HIV status made by vulnerable women in South Africa (Stadler et al., 2015).

A final difficulty discussed was that of communicating in a multi-language environment including non-South African languages. All the case clinics are situated in the inner-city of Johannesburg, where there are substantial numbers of migrants from African nations to the north. The Health Promoter at Clinic C estimated that on some days almost half of the pregnant women coming to see an ANC nurse could be from outside South Africa.

This was expressed in the following words at Clinic B:

" It's just that here there are a lot of foreigners so that is making the numbers to be unmanageable ... they make the clinic to be filled to the brim. So there's nothing we can do." (Interview 5)

Some of these migrants cannot speak any South African language, which in addition gives rise to communication difficulties:

"(The health department) said they will train people, they will organise interpreters, (but) up to date, nothing" (Interview 5)

Table 16 below summarises the conditions at each clinic.

Clinic		Clinic A	Clinic B	Clinic C
Activities and Conditions				
General Conditions	**Location**	Central city, in a park.	In a side street. At the transition from the central city to neighbouring suburbs. About 4km from the city centre.	On an arterial road about 8km from the city centre. Arterial road connects to a large freeway running less than 2 kilometres.
	Surrounding Conditions	High density low-income flats.	Low income free-standing residential properties. Small businesses nearby (e.g. car body repair, workshops) lining the nearby arterial road.	Low income free-standing residential properties on the one side of the road, and high-density low rise and informal housing on the other. A mixture of large retail stores, various small businesses (e.g. informal traders, hair salons, fast food) and administrative offices (for the nearby light industries) lining the arterial road.
	Catchment Area for Clinic Clients	Residents of surrounding area as well as travellers passing through.	Residents of surrounding area.	Residents of surrounding area as well as office workers.
	Other Notable Features	Long-distance terminus for train and bus travel close by.	None	Long-established hostel (rudimentary accommodation for mine workers) on the far side of the low rise housing.
	Hours	8am – 4pm	8am – 4pm	8am – 4pm
Physical Conditions	**Clinic Manager**	Nursing Sister	Nursing Sister	Nursing Sister
	ANC Size	Small (one professional ANC nurse)	Medium (one professional ANC nurse)	Medium-large. Two floors. (two professional ANC nurses)
	Layout	Outside area for queuing (seated) as well as entrance corridor before the registration desk. Internal waiting area after the entrance corridor. Consulting rooms off the waiting area.	No provision for queuing outside. Large central waiting area inside. Registration desk inside the entrance. Consulting rooms off the waiting area or down a corridor.	Internal area for queuing in front of the registration desk. After registration clients were directed to appropriate sections of the building.

	ANC Facilities and MomConnect Details.	Single small consulting room. Client details for MomConnect registration were usually taken in a separate (unused at the time) consulting room, or sometimes outside if the weather was suitable.	Single, large dedicated consulting room. Sometimes MomConnect registration took place in a separate room if it was not carried out under the supervision of the permanent ANC nurse.	Two consulting rooms after a single dedicated waiting room. Client details for MomConnect registration were taken in the dedicated waiting room.
Services Offered		Antenatal Care	Antenatal Care	Antenatal Care
		Child Health	Child Health	Child Health
		Chronic Care	Chronic Care	Chronic Care
		Curative Services	Curative Services	Curative Services
		HIV / AIDS / VCT	HIV / AIDS / VCT	HIV / AIDS / VCT
		Reproductive Health	Reproductive Health	Reproductive Health
		Tuberculosis	Tuberculosis	Tuberculosis
Challenges and Tensions Stated	**Management**	Nurse training necessary but increases stress on other nurses.	Insufficient staff numbers. Trade-offs implicitly led to service levels dropping in some areas.	Low levels of timely ANC attendance were noted as a management challenge regarding ANC
	Staffing	Former NGO employees were absorbed into the clinic shortly before field work started. One resigned during the course of the research.	The ANC nurse was initially a full-time employee. A contract nurse replaced her for about six months.	The initial two ANC nurses had to be scaled down to one because of the high demand for TB services. WBOT dissolved over the course of the study.
	Clients	Clients arrived from taxi ranks and trains attending clinic. Clinic staff started to ask for proof of residence so that local people would not be disadvantaged.	Poor communication with foreigners unable to speak one of the (eleven) official languages.	Poor communication with foreigners unable to speak one of the (eleven) official languages. High population in the vicinity but many people unwilling to attend the clinic.

Table 16 Comparative Summary of Clinic Conditions and Activities (Researcher's Interview Transcripts and Observations)

During the interviews, a contrast emerged between nurses and health intermediaries. Most nurses had been in the profession for over a decade. In contrast, the health intermediaries had all been employed in clinics for less than five years, and many of them had either not been formally employed prior to joining the clinic or worked outside of government health care sector. Most interviewees were forthcoming about themselves and their experiences with MomConnect, However, the nurses were generally forthright with both positive and negative opinions, while the health intermediaries often took some time before touching on sensitive topics such as frustration with the expectations placed on them in the clinic, and their working conditions.

5.3 Case Analysis: MomConnect Coordination in the Workplace

The previous section detailed the MomConnect project details and overviewed the clinic environments. This section further outlines the routines of MomConnect registration and details their dynamics to provide a framework for the subsequent analysis.

Building on this, the section goes on to analyse mHealth in the workplace in terms of the categories of coordination previously identified in Table 3 of Chapter 3. The options outlined in the training material for MomConnect registration are re-analysed, employing the elements of coordination as developed in the Literature Review and set out in that table. By tracing coordination as a process involving both staff members and clients, the analysis enhances understanding of the implications of the setting for MomConnect registration.

5.3.1 Routines of MomConnect Registration

Section 5.2 set out, in Table 15, the registration routines envisaged in the official MomConnect training material. This section analyses the routines of MomConnect registration that were identified at the clinics through interviews and observation. These routines are described in terms of the coordination mechanisms.

Table 17 below sets out that analysis schematically; the subsequent text describes the routines in detail.

Coordination Mechanisms per Routine		MomConnect Registration Phase		
		Engaging	**Gathering Information**	**Registering**
Routine 1	**Social**	**Roles**: Health Promoter or other intermediary provides a health education class to the pregnant women attending ANC Women gathered together in room for health education class	**Roles:** Nurse provides consultation to pregnant woman. Calculated EDD	**Roles:** Data Capturer enters MomConnect registration data
	Relationships			
	Artefacts	**Client File:** Collected by the pregnant woman at the Reception Desk	**Client File:** Choice to sign up (or not) recorded here and returned to the woman **Pregnancy Wheel:** Used to determine EDD. Recorded in Client File	**Client File:** Woman hands file with details to Data Capturer to enter **Personal Mobile Phone:** Belonging to Data Capturer
Routine 2	**Social**	**Roles**: Health Promoter or other intermediary provides a health education class to the pregnant women attending ANC Women gathered together in room for health education class	**Roles:** Nurse provides consultation to pregnant woman. Calculated EDD	**Roles:** Nurse registers the pregnant woman in the consultation if she consents
	Relationships			
	Artefacts	**Client File:** Collected prior to the class by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File	**Client File:** Left in the consultation room **Personal Mobile Phone:** Belonging to the nurse
Routine 3	**Social**		**Roles:** Nurse provides consultation to pregnant woman. Calculated EDD.	**Roles:** Data Capturer enters MomConnect registration data OR Nurse registers the pregnant woman in the consultation if she consents
	Relationships	Clinic staff member hands out informational fliers to pregnant women as they wait for a consultation		
	Artefacts	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File	**Personal Mobile Phone:** Belonging to the Data Capturer or nurse

Table 17 Recommended Registration Routines Analysed in terms of Coordination Mechanisms (see Table 15)

An analysis of the routines contained in Table 17 above show how the descriptions in the training material can be broken down into elements contained in the coordination studies perspective developed in Chapter 3.

5.3.1.1 Social Coordination

The routines presented Table 17 above specify social mechanisms as central to the coordination of MomConnect. This is in line with the literature on the strong roles associated with the health workplace.

Plans, Rules and Roles

The MomConnect rollout process was carried out in 2014 after the official launch of the initiative. Training workshops were held with clinic staff around the country. All the nurses interviewed stated that they had either been introduced to MomConnect in a workshop or – if they had not been in the ANC unit at the time – were shown how to use it by a nurse who had been trained.

By contrast, only one of the health intermediaries interviewed indicated that they had attended a MomConnect registration training session. Two of them indicated they had been trained by the ANC nurse.

Routines

Rereading Table 15 as a set of alternative routines suggests a sequence of activities. Each routine consists of common phases of first engaging the client, then gathering the information needed for registration, and finally carrying out the registration process itself. Engaging the client involves introducing the concept of MomConnect to the pregnant woman, either before consultation with the ANC nurse or as part of a health promotion talk delivered in advance. Gathering information may take place as a single activity when performed by the nurse, or as a series of activities when the health intermediary collects some information prior to consultation and adds in the EDD information afterwards. Similarly, registration may take place as part of the ANC consultation with the nurse, or afterwards through a health intermediary.

When describing the routines that were observed in the different clinics, the terms *integrated* and *delegated* are used to characterise them. *Delegated* refers to a routine where the registration on the cell phone is performed by a health intermediary at a later stage (i.e. Routines 1 and 3 in Table 17). *Integrated* refers to a routine where the registration on the cell phone is carried out as part of the consultation with the nurse (i.e. Routine 2 in Table 17).

Registration routines sometimes switched between delegated and integrated forms at a single clinic. The changes in registration routines over time are shown in Figure 12, Figure 13 and Figure 14. All of these figures allow space to display delegated or integrated forms, whether both appeared or not, to make them easier to compare.

5.3.1.2 Relational Coordination

Relational coordination was not envisaged as playing a significant role in the training material. This rests on an assumption that the nurses and health intermediaries will work smoothly together in ensuring registration takes place. It is absent from the description of the formal routine.

5.3.1.3 Artefact-Based Coordination

The three artefacts noted in the recommended registration routines are the client file, the pregnancy wheel (see above) and the mobile phone used for registration. The client file and the pregnancy wheel are artefacts well established in the coordination of existing ANC work practices. The mobile phone is introduced as a data capture device that may be used by the health intermediary, the ANC nurse or a data capturer.

The registration routines identified in the fieldwork at the Johannesburg clinics all pinpointed either the health intermediary or the pregnant women herself as the actor actually carrying out MomConnect registrations. As noted above in 5.1, staff identified as data capturers were dedicated to entering HIV/AIDS medication records and were not involved.

5.3.2 MomConnect Registration at Clinic A

Clinic A was the smallest and most central of the clinics under study, based in an area with a high population density, with, as the manager at Clinic A phrased it above, “three, four five” families in a single one-room flat.

Other clinics nearby had been closed before the field study started. The manager at Clinic A cited this as one contributory reason for the large number of clients. In addition the clinic’s location in the CBD meant that not only nearby residents but also people working in the area attended:

“... the reason why it's busy, it's in the CBD area, people are working here. (And they) are staying far away, staying in Soweto, or whatever. And then they work here. ... I think they don't have the job security where they cannot go to work (to attend a clinic close to home). So they prefer going to work and then they come here whenever they feel like they want to be seen and then go back to work again.” (Interview 7)

The staff complement in 2015 at Clinic A directly involved in providing health care services consisted of six professional nurses, two auxiliary nurses, one health promoter, four ACT counsellors and four EPWP workers. In addition there were two clerks, cleaners and a gardener. Two health intermediaries who had previously been working for an NGO now worked at the clinic and reported to the nursing staff there, but were employed directly by the City of Johannesburg Department of Health. This is in line with government policy initiated as far back as 2008 (Clarke et al., 2008), but still being implemented by the City of Johannesburg.

The one ANC nurse at Clinic A had a permanent office in the clinic building. This room was not large enough to accommodate the 7-10 women typically attending their first antenatal class. The offices not allocated to nurses were used for various clinic purposes on an ad hoc basis, but neither were any of them large enough to comfortably accommodate all the pregnant women at the same time. Health promotion talks were therefore given in any other suitable office that could be identified by the health intermediary at the point when the talk needed to be delivered.

5.3.2.1 Social Coordination

Social mechanisms played a major role in shaping the coordination of MomConnect. This again concurs with the literature on the highly structured nature of the health workplace. Most notably, the nurses – in line with their position of authority within the clinics – were the ones attending the training sessions. The ANC nurse at Clinic A confirmed that she was the person who had received training in MomConnect registration.

In line with existing literature on the delegation of data entry from higher- to lower-status health professionals in HIT (Kane & Labianca, 2011), the work of MomConnect registration was delegated to the health intermediaries. See the section on Routines below for more detail.

Plan, Rules and Roles

The facility manager at Clinic A had been in role for three years at the time of the interview, in 2015. Previously, they had managed another clinic for five years.

The ANC section at Clinic A consisted of one nurse supported by two health intermediaries, although the number of health intermediaries involved in MomConnect registration changed over time. The role of the nurse versus the health intermediaries was quite distinct and clearly defined. The health promoter was an employee of the clinic and was not involved in MomConnect registration. The two health intermediaries previously employed at NGOs were appointed as volunteers on a limited stipend, paid on a month-to-month basis and with no formal leave (Schneider et al., 2008).

They identified themselves as not merely clinic employees, but also as responsible to engage in community work:

"... we help the sisters ... and if we are not busy with the sisters then we can go and do health work (the outreach program) " (Interview 10)

The EPWP workers were not involved in MomConnect registration. Instead, they were given responsibility for specific tasks (e.g. ACT counselling or going out and finding clients not taking their chronic medication for TB or HIV/AIDS, known as 'tracing'). In addition to these tasks they were also required to assist the nurses with tasks such as taking vital signs, conducting urine tests and doing general work such as unpacking medical supplies and stacking them in the clinic fridge.

Routines

Field work at Clinic A in 2015 revealed the different ways in which the health intermediaries had been involved in the registration process. The health intermediary I was directed to described how initially the MomConnect registration process at Clinic A had involved two health intermediaries and the ANC nurse. The intermediaries informed pregnant women queuing for attention about MomConnect. Later, the women were registered via a routine very similar to Routine 3 in Table 17. The health intermediary interviewed later in 2015 however noted that their colleague had since resigned and the MomConnect registration routine was now carried out differently. The remaining heath intermediary now made a group health promotion presentation to the pregnant woman who had come for their first ANC visit. The details needed for MomConnect registration were then gathered and recorded in an exercise book. The women then went individually to an appointment with the ANC nurse, where they were examined and their EDD recorded on their card.

The health intermediary would later take the cards, transfer the EDD details from the cards into the book and perform the registration process on their own mobile handset at a later date. This was in line with Routine 1 in Table 17. Field work in 2016 revealed that the same health intermediary was performing registrations as in 2015. The process that was followed was the same as that identified in 2015. The health intermediary had taken leave for a month over January 2016. The ANC nurse working over this period reported that they had collected all the necessary data and entered it in the official notebook for the health intermediary to capture when they returned to the clinic.

During the last interview with the health intermediary who had been doing registrations for the full 15 months of the field work, they reported that they were going to join a new WBOT that was being formed at the clinic in the next few weeks. When asked how long they would be out for, they responded:

“Every day. My job is outside!” (Interview 21)

And laughed when asked if they would enjoy that more than working inside the clinic. This aligns with the interest in and enthusiasm for community outreach that was reported by other health intermediaries (see 5.3.2.4).

Despite the pressure of being the sole person responsible for registrations and not having support from the ANC nurse when they were on leave, they also expressed concern at what would happen to MomConnect registration:

“Sjoe! It is too difficult! Because you know if I am going outside, I don’t know who is going to make Mom Connect inside! Because you know Mom Connect they do early in the morning, so me, by 8 or 8.30 maybe I will go out. But maybe I will make a plan. I don’t know what.” (Interview 21)

The routines reported from 2015 and 2016 are set out in Table 18, together with notes on how this coordination differed from the recommended routines in Table 17. A schematic diagram summarising how the routines shifted over time is set out in Figure 12, together with key events such as staffing changes and role shifting.

Figure 12 Registration Routines over Time at Clinic A (Researcher's Interview Transcripts and Observations)

5.3.2.2 Artefact-Based Coordination

As set out in Table 17 there were a variety of artefacts supporting MomConnect registration. Interviews and general observation at the clinic revealed unexpected variation between clinics. Before clients could enter ANC, they were required to provide proof of identification (a South Africa ID document, or passport in the case of a foreign national) so that their file with their medical history could be retrieved. In 2016 Clinic A also required proof of residence before being permitted to enter the clinic, as discovered while performing general observation of daily clinic routine.

When probing this with the clinic manager it was reported that this was because many people passed by the clinic because of the train station and taxi rank nearby. These people made use of the clinic and client from the surrounding areas struggled to access clinic services as a result:

"Everyone was coming here before, it was creating a problem for the people (living nearby who could not get access to the clinic), if you stay next to this clinic you are supposed to come here, but if you are staying in Soweto you must not come here at 5am. So that was the reason why we wanted the proof of address" (Interview 22)

The health intermediary was required to check for this proof of residence and direct people away if they could not prove that they were from the surrounding area.

The health intermediary at Clinic A had a exercise book (supplied by the clinic) which was used to capture pregnant women's details i.e. name, identity number (or passport number) or month of birth, mobile number for message delivery, EDD for the current pregnancy and language in which messages are desired. These details (excluding the name) were later entered using the MomConnect registration system.

The mobile phone used in MomConnect registration at Clinic A was the personal mobile phone belonging to the health intermediary. This phone was often charging when I spoke to the health intermediary, who complained that the phone was old and that MomConnect registration was not easy as a result. This was particularly because the battery life was low and the screen was cracked, making rapid entry of information via USSD quite challenging. This was reported as:

"so no one give(s) me a phone, so everything is going terrible but all the time the national wants the stats, but they don't give me the phone to make this Mom Connect! I don't know what we can do. Because you know what, all the time my battery is (drained)". (Interview 21)

This not only impacted on the ease with which MomConnect registrations could be performed, and possibly the completeness of the data captured, but also impacted on relationships with the

pregnant women that the health intermediary interacted with all day. This is discussed further in section 5.3.2.3 below.

5.3.2.3 Relationships

MomConnect registration in Clinic A was marked by a clear delegation of authority from the ANC nurses to the health intermediary. The health intermediary at Clinic A who was interviewed in 2015 and 2016 was a volunteer, and as such working on a month-to-month basis on a small stipend.

The health intermediary was positive about work at the clinic all through the study period. However becoming solely responsible for MomConnect registrations after the other one resigned in 2015 increased the pressure they experienced.

The ANC nurse interviewed in 2016 noted that they had recorded the information required for the MomConnect registrations in January 2016, for the health intermediary to enter when they returned after a month on unpaid leave. This particular nurse had reported that in her previous clinic she had performed MomConnect registrations herself, but did not bother to do this additional step while the health intermediary was away. This suggested that relational coordination in Clinic A was undeveloped.

MomConnect (via the handset) not only linked the health intermediary more closely to the clinic manager, but also linked the health intermediary to the district health office:

"(The district manager) complains, because ... at the end of the month ... there are supposed to be about ..... 80 people registered ... So because of that problem, IDs and passports … I find the people are maybe 41 or 20 something – because there are no passports! Because you know what, you don't go through Mom Connect if you don't have a passport. Because that thing they ask them, the ID or passport of the patient – if you don't have it, what can they do? Or maybe they give us the passport and it is expired. So that is why it is not going through." (Interview 21)

MomConnect also linked the health intermediary with the clients that they worked with all day long. This was mediated through the issue of whose mobile phone was to be used for registrations:

You know what, you know the pregnant women, most of the time they have an attitude. If I say 'I want you to use your phone' they say 'no no no'. You see? It is like a fighting! So that is why I am choosing to use my phone because I want to stop the things of fighting with the pregnant women! (Interview 21)

This evidence clearly demonstrates that the artefact of the mobile handset was not simply a functional implement for data capture, but was implicated in mediating relationships between

different clinic staff, and between the health intermediary and the pregnant women that were she dealt with every day.

5.3.2.4 Unexpected Findings

A number of issues were raised by informants in the open-ended interviews or in informal discussion that had some relationship to coordination, and yet did not fit into the categories of the coordination studies perspective. The abductive approach described in Chapter 3 emphasises that unexpected discoveries are a prompt for the development of new insights as well as theory (Timmermans & Tavory, 2012).

These issues fell into the broad categories of roles, accountability and routines and are described below.

Roles. General observation that was undertaken in all of the clinics revealed that in each one the support staff did not only take on the work that fell under their official duties. When observing clients queuing in the mornings, it soon became evident that the non-professional staff worked together to help the processing of the queues move efficiently. Clerks, health promoters and other staff would direct the clients on where to queue, check that they had appropriate documentation while they were waiting and help direct clients to the right section of the clinics once that had received their files from the reception desk.

By mid-morning, the support staff would return to their usual roles. This was unexpected in a public service environment where clearly defined and structured roles are the norm. On reflection, the appearance of this phenomenon was not altogether unexpected in a resource-poor environment run by medical professionals, and helped to make sense of the forms of coordination where support staff took on most of the work of MomConnect registration. It has not been identified in the literature on primary health care literature in developing countries, or in the mHealth literature to the knowledge of this researcher.

This phenomenon was also encountered at the other clinics. The significance of these observations is discussed at a higher level in 5.3.6.2.

Accountability. Interviews and informal conversations at all of the clinics clearly identified a sense of accountability from the health intermediaries not only to the nursing staff in the clinic but also to the broader community:

"We go and do outreach and we do programs and when we go to the brothels we facilitate about health ... and we talk to the ladies in the brothels" (Interview 10)

and in response to a query on the response received to outreach there:

“They listen actually. They know it is something that they need right, like condoms.. They use them every day – so we do (outreach).” (Interview 10)

Another health intermediary said unprompted:

“ .. if we go out and see that there is a problem in the community then we can alert the clinic and be able to refer people from the community to come and access the clinic – and we are not doing that! ... But you see those people standing there, if I can go there to them now and talk to them about health issues – bring my table, bring the banners, have some information and I talk to them about issues – then they will be able to interact with me, freely." (Interview 13)

and:

"I go out because sometimes we just have to do that, walk into schools, walk into old age homes, just to create that hope." (Interview 13)

This phenomenon was also encountered at Clinic C (see 5.3.4.4). The significance of these observations is discussed at a higher level in 5.3.6.3.

Routines. As noted under 5.3.2.1, the health intermediary who was responsible for MomConnect registration was on unpaid leave in January 2016. The ANC nurse stated that she had recorded all the registration details in the exercise book but had been unable to perform the registration process in their absence. Under the best of conditions MomConnect registration had to contend with a host of other duties every day.

It seemed virtually impossible for the heath intermediary to catch up on the backlog of registrations given what had become clear about the pressures that clinic staff worked under. Given the vulnerable position of the health intermediary, and my position as an older white male in South Africa, I was sensitive to the power differential between the two of us. In interviewing this health intermediary for the last time I was thus careful not to probe this issue directly.

I asked in general how registration was going, and the health intermediary stated that they did not have all the required information from January, directly contradicting the ANC nurse. On the same day I interviewed the clinic manager, who stated that although not all the women were being registered she was happy that approximately 75% were being registered, and ascribed the shortfall to the network problems with registrations:

"(when the pregnant women come for their) first visit they are normally 70 or 80, then (the health intermediary) will connect about 50 ... patients, I think it has improved, although it is still not 100%. (Interview 22)

Considering these contradictory descriptions, being reluctant to probe directly and damage the relationships I had formed with the informants, I came to the conclusion that there was an unstated agreement that management accepted that registrations would be done when they could be accommodated despite the expectations of the district. In other words, there were registration routines that deviated from the official descriptions that were tacitly accepted.

5.3.2.5 Summary

Social coordination, and in particular the roles of the different staff, played a dominant role in governing the form that registration routines took. MomConnect registration at Clinic A was coordinated on the basis of delegation of responsibility to health intermediaries to carry out at a later date. Initially this was performed by two health intermediaries who gathered information from women waiting in the queue before seeing the ANC nurse. This routine is very similar to Option 3 described in the official training material (see Table 15). However rather than simply hand out informative flyers to the pregnant women there was personal interaction with them.

One of the health intermediaries had resigned before the first full interview could be conducted. At this stage the remaining health intermediary was carrying out registrations after collecting the pregnant women's details, after their health presentation to the women, and before they went into consultations with the ANC nurse. The ANC nurse determined the EDD in the course of the consultation. This information was consolidated with the other details before the registration were performed.

This routine is similar to Option 1 (see Table 15) but rather than the registration being performed by a Data Capturer it was actually carried out by the health intermediary.

Relational coordination was not evident between nurses and health intermediaries at Clinic A. More energy was directed towards relationships with people requiring health care, either those attending the clinic (from nurses) or the broader community (from health intermediaries).

Coordination Mechanisms		MomConnect Registration Phase		
Period	**Type of Mechanism**	**Engaging**	**Gathering Information**	**Registering**
2015 (a) Delegated: Variation on Routine 3	**Social**	**Roles:** Two health intermediaries approached pregnant women while they were queuing to inform them of MomConnect	**Roles:** The two health intermediaries requested information from the women in the queue who wanted to register. The ANC nurse identified the EDD in a private consultation.	**Roles:** Registration was performed after the consultation by the health intermediaries
	Relationships	**Clients:** In the queue complained about being engaged while waiting		
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File by ANC nurse	**Client file**: The EDD was identified from the file by the health intermediaries **Personal Mobile Phone:** Belonging to health intermediary
2015 (b) Delegated: Routine 1	**Social**	**Roles:** Single remaining health intermediary gave a health promotion presentation to the pregnant women in a separate room	**Roles:** The ANC nurse identified the EDD in a private consultation	**Roles:** Registration was performed after the consultation by the health intermediary
	Relationships			
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File by ANC nurse	**Client file**: The EDD was identified from the file by the health intermediaries **Personal Mobile Phone:** Belonging to health intermediary
2016 Delegated: Routine 1	**Social**	**Roles:** Single remaining health intermediary gave a health promotion presentation to the pregnant women in a separate room	**Roles:** The ANC nurse identified the EDD in a private consultation	**Roles:** Registration was performed after the consultation by the health intermediary
	Relationships			
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File	**Client file**: The EDD was identified from the file by the health intermediaries **Personal Mobile Phone:** Belonging to health intermediary

Table 18 Coordination Mechanisms supporting MomConnect Registration Routines at Clinic A (Researcher's Interview Transcripts and Observations)

5.3.3 MomConnect Registration at Clinic B

Clinic B was in between the other two clinics in terms of internal building space. It consisted of a number of a large central waiting area (approximately 15m by 18m) surrounded by offices where nurses would attend to clients. The rows of seats were located in the centre of the waiting area and were arranged in groups facing the different walls. Clients waiting to attend the offices on different sides would be directed to the group of seats nearest to these offices. As in Clinic A the clients would queue and pick up their folders from the reception area when they reached there. In contrast to the other two clinics the ANC office was relatively large, approximately 3m by 4.5m.

The clinic manager stated that MAMA had worked better because there was a dedicated person responsible for registering the pregnant women:

"(MAMA worked) better because there were people allocated, the difference was there was one body to (register the women)" (Interview 6)

5.3.3.1 Social Coordination

The relative role played by different members of staff in MomConnect registration at Clinic B changed substantially between the two rounds of field work.

Plans, Rules and Roles

Like Clinic A, Clinic B displayed strong role differences between the nurses and health intermediaries. Again like Clinic A, the staffing changed over the course of the field study. A permanently employed nurse was in charge of the ANC and MomConnect registrations at the time of the field work carried out in 2015. In 2016 the ANC was being run by another nurse who had been appointed on contract directly by the City from September 2015. Before the last interview was completed at Clinic B in 2016 the nurse who had initially been in charge of the ANC in 2015 was running it again as the contract nurse's time had elapsed.

The role of health intermediaries changed between 2015 and 2016. In 2015 there was a health intermediary involved in performing the registration process who identified themselves as a counsellor for clients who were about to undergo a test for HIV/AIDS. There was a health promoter at this clinic but they were not involved in supporting the ANC nurse and in MomConnect registration.

Interviews were held with the responsible nurse and the health intermediary in 2015 and the contract nurse as well as the permanent nurse in 2016.

Routines

MomConnect registration at Clinic B in 2015 followed a quite different routine to the one that had been identified at Clinic A. In 2015 the health intermediary and ANC nurse shared the work of MomConnect registrations with the clients.

The pregnant women were called into the large ANC office. The health intermediary would then make a general health promotion presentation. The nurse then complemented the initial presentation with specific symptoms of conditions likely to lead to severe complications that the women should be aware of, and should attend clinic if they occurred.

After this the ANC nurse asked the clients to take out their cell phones, and gave them instructions on how to register themselves for MomConnect. This process involved making the clinic code known to all the pregnant women, and calculating the EDD for each one of the women in the room. The ANC nurse spoke to each woman in turn to determine their EDD, after which they could do their own registration.

Some women experienced difficulty in registering themselves. The strategy that was taken was to first direct the woman to ask for help from her neighbour. If this was not successful then the health intermediary would investigate and conclude the registration process.

As in Clinic A the dropped registration sessions (because of the nature of USSD) were noted as a problem for successful registrations in interviews with the clinic managers and health intermediaries, and in Clinic B also the ANC nurse.

On returning to the field in 2016 and visiting Clinic B it became apparent that quite different registration routines were in place. Registrations were being performed by the contract nurse for the duration of assignment to the clinic, in line with Routine 2 in Table 17. Two months later a permanent nurse in the ANC had taken over responsibility for MC registration. This nurse was the senior nurse who had been working in the ANC in 2015. It was confirmed that the MomConnect registration routine took place in a group as was identified in 2015, with mothers registering themselves on their own handsets but with no health intermediary involved. However the ANC nurse was training two of the administrative staff how to guide the pregnant women in doing MomConnect registrations at the end of the 2016, apparently in response to the volunteers' unwillingness to assist (see 5.3.3.2). These changes are summarised in Figure 13 below.

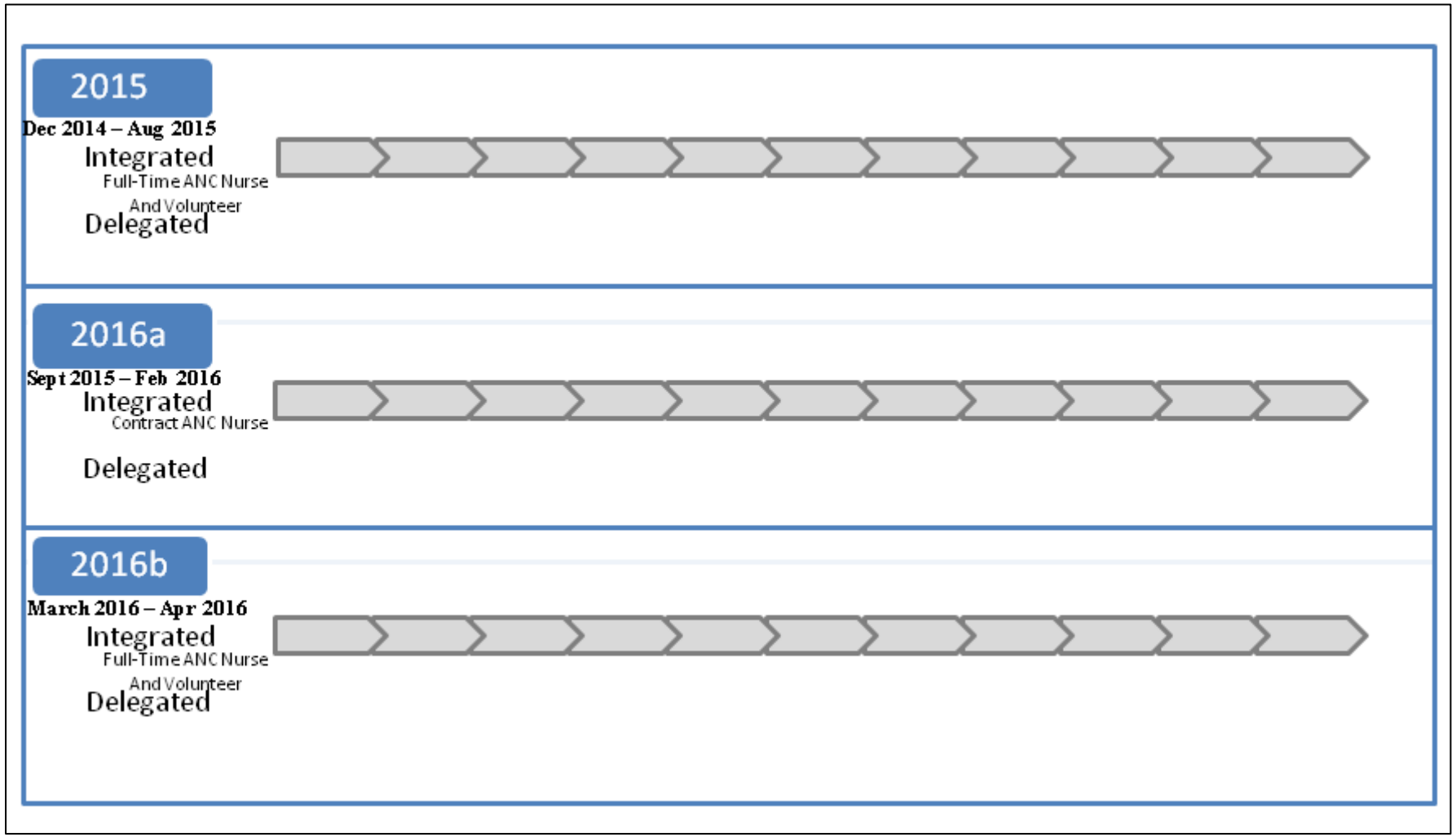


Figure 13 Registration Routines over Time at Clinic B (Researcher's Interview Transcripts and Observations)

5.3.3.2 Relationships

In 2015 Clinic B displayed a greater level of relational coordination than Clinic A. The work of registration was completely handed-off to the health intermediary in Clinic A. In Clinic B the ANC nurse and health intermediary worked together in the same office in 2015 to counsel the pregnant women and guide them in carrying out MomConnect registrations.

However in 2016 when after the contract nurse had left, in the last interview with the permanent ANC nurse they indicated that the health intermediaries were not enthusiastic to become involved in MomConnect registration:

"Yes, all the volunteers know how to do (MomConnect registrations by themselves). But ... they don't want to…. They will tell you 'we are not nurses, we are not earning enough' ... But they know because we taught them." (Interview 23)

5.3.3.3 Artefact-Based Coordination

Unlike Clinic A, there was no requirement for proof of residence before clients were admitted to the clinic. Unlike Clinic A, there was no exercise book used to record the pregnant womens' details. It was not necessary as the registrations were performed with the pregnant women in the room.

5.3.3.4 Unexpected Findings

Roles. Like Clinic A, Clinic B displayed the same temporary switching of roles in the mornings where health intermediaries and support staff worked together to manage the queues of clients until they had all received their files and been directed to where to sit, in the central seating area.

Like Clinic A this was observed on all days that observation was carried out, and in both 2015 and 2016.

5.3.3.5 Summary

Like Clinic A, MomConnect registration at Clinic B was arranged on the basis of social coordination; driven by the preferences and choices of the nurses. The permanently appointed nurse who worked in the ANC ensured that she had assistance from a volunteer or colleague when performing registrations, although the volunteers were reluctant to be involved.

While the people involved in the registration routines changed over the course of the field study, registration was always integrated with the consultation between the ANC nurse and the pregnant women.

		MomConnect Registration Phase		
Clinic	**Type of Mechanism**	**Engaging**	**Gathering Information**	**Registering**
2015 **Integrated:** Jointly with health intermediary Not provided for in the Training Material	**Social**	**Roles:** The pregnant women were invited into the ANC room. The ANC nurse gave a health promotion presentation to all the assembled women	**Roles:** The women did not provide their information. They were given the clinic code to enable them to perform the registration process themselves.	**Roles:** The women were verbally guided through the registration process in a group by the ANC nurse, with the health intermediary going to each woman in turn to see if they were registering successfully
	Relationships		**Clients:** Individual interaction with the ANC nurse (see below)	**Clients:** Individual interaction with the health intermediary
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD in separate conversations while the group was assembled	**Client file**: The EDDs were identified in personal discussions while the group was assembled. Later recorded in the file for reference **Personal Mobile Phone:** Belonging to each pregnant woman (or health intermediary when registration was unsuccessful)
2016 (a) **Integrated:** **Routine 2**	**Social**	**Roles:** The ANC nurse discussed MomConnect with each woman in the individual consultations	**Roles:** The information was gathered by the ANC nurse in the consultation	**Roles:** Registration was performed by the ANC nurse in the consultation
	Relationships			**Clients:** I
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File.	**Personal Mobile Phone:** Belonging to the nurse
2016 (b) **Integrated:** Not provided for in the Training Material	**Social**	**Roles:** The pregnant women were invited into the ANC room. The ANC nurse gave a health promotion presentation to all the assembled women	**Roles:** The women did not provide their information. They were given the clinic code to enable them to perform the registration process themselves.	**Roles:** The women were verbally guided through the registration process in a group by the ANC nurse.
	Relationships		**Clients:** Individual interaction with the ANC nurse (see below)	**Clients:** Individual interaction with the health intermediary
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD in separate conversations while the group was assembled	**Client file**: The EDDs were identified in personal discussions while the group was assembled. Later recorded in the file for reference **Personal Mobile Phone:** Belonging to each pregnant woman

Table 19 Coordination Mechanisms supporting MomConnect Registration Routines at Clinic B (Researcher's Interview Transcripts and Observations)

5.3.4 MomConnect Registration at Clinic C

Clinic C was the largest clinic of the Johannesburg clinics in the study. Among these clinics it was located furthest from the city centre and not far from an old mining hostel. Such hostels were originally established to house migrant workers employed on the mines from the late nineteenth century onwards (Bezuidenhout & Buhlungu, 2011). This was the time when the gold was discovered and the city of Johannesburg developed around this industry (Stadler & Dugmore, 2017).

Clinic C had a number of sections dedicated to different types of care. Groups of offices located together housed staff providing services such as the ANC, mother and child (under five years old) care, and the diagnosis and monitoring of chronic conditions such as TB and HIV/AIDS. Unlike the other clinics this one had a main waiting area and separate waiting areas for the different groups of offices.

In the case of ANC services there was a single room leading off the main waiting area where pregnant women were gathered for health promotion talks. This room was linked directly to the two dedicated offices for ANC consultations, each staffed by a separate ANC nurse.

5.3.4.1 Social Coordination

Social coordination at Clinic C was more varied than at the other clinics which was particularly evident in the variety of routines that played out in shaping the coordination of MomConnect. The routine shifted to involve health intermediaries with a range of different designations over the course of the field work, from health promoter to WBOT members.

Plan, Rules and Roles

The MomConnect rollout process was carried out in 2014 after the official launch of the initiative. Training workshops were held with clinic staff around the country. All of the nurses interviewed either stated that they had been introduced to MomConnect in a workshop or if they were not in the ANC unit at the time they were shown how to use it by a nurse who had been trained. The one health intermediary who performed MomConnect registrations in 2015 stated that they had attended a MomConnect registration training session, unlike the health intermediaries at Clinic A and Clinic B.

There were several health intermediaries at Clinic C. The health intermediary responsible for MomConnect registration in 2015 was a health promoter. As a health promoter this intermediary had a two-year diploma in contrast to the volunteers doing registrations at the other clinics. In 2016 there were other health intermediaries at Clinic C, consisting of a WBOT leader (a registered nurse)

and three team members. As noted in Chapter 2 the WBOTs were formed on the basis of a long-standing initiative of the NDoH as part of the move to strengthen PHC (National Department of Health: Republic of South Africa, 2011), and spurred by the planned implementation of the NHI (National Department of Health: Republic of South Africa, 2018).

The WBOT was not part of the formal clinic staffing which was reflected in the fact that they were paid not through the clinic but directly from the City of Johannesburg health department. Before the field work was concluded in 2016 the WBOT was no longer present at the clinic. During the a site visit towards the end of the second round (in 2016) at Clinic C the remaining health intermediary at the clinic informed me that the health department payments for the team had not come through and that the team members were not coming in to the clinic as a result. The team leader was not present because they had gone in person to the Human Resources section at the department.

The next time that Clinic C was visited some two weeks later neither the team leader nor the team members were present. I followed up in an informal conversation with the health intermediary that had participated in interviews previously indicated. They indicated that no further payments had been forthcoming from the health department and until this happened the WBOT would not assemble again.

Routines

MomConnect registration at Clinic C followed a consistent routine in 2015. The health promoter brought the pregnant women into the anteroom and gave a health promotion lecture. At the end of the lecture the women were given the opportunity to be registered for MomConnect.

The women who were interested gave their names and registration information and it was entered in an A5 book by the health promoter. The women then moved one by one on to a linked ANC office where they each engaged separately in a consultation with the ANC nurse. The nurse recorded their EDDs during the separate consultations in a file.

The health promoter then copied the EDD dates into the A5 book with the other MomConnect registration information. MomConnect registration was performed at a later stage when the health promoter could find time to sit down and do this work. Unlike work involving direct interaction with clients MomConnect registration was less time sensitive which was perceived as a distinct advantage.

On returning to the field in 2016 the registration routine followed the same delegated pattern, with an initial presentation and collection of the information from the women followed by the ANC consultation. As before, the EDD was collected from the ANC card filled in by the nurse and all the

information was registered at a later date. The health intermediary interviewed early in 2016 had also been doing registration in 2015, but reported that they were extremely busy and as a result took the details home and did the registrations there, out of office hours with the assistance of their partner:

"my (partner) sometimes does (MomConnect registrations). I think (they) likes that ... and ... (they) knows how to do it." (Interview 16)

This health intermediary reported that they were sometimes assisted by a member of the WBOT, but that the team members were not keen to get involved with the registrations. I was able to interview the head of the WBOT who reported that they would also sometimes help out doing the registrations, but that the first health intermediary would still do the informational presentation at the beginning.

All of these formal and informal interactions indicated that the registration routines shifted as additional, and more junior, staff became available to help out, and also suggested that similarly to Clinic A there was an implicit acceptance that MomConnect registration would not always be fully completed.

The routines by which MomConnect registration took place and the events coinciding with changes in available staff are summarised in Figure 14 below.

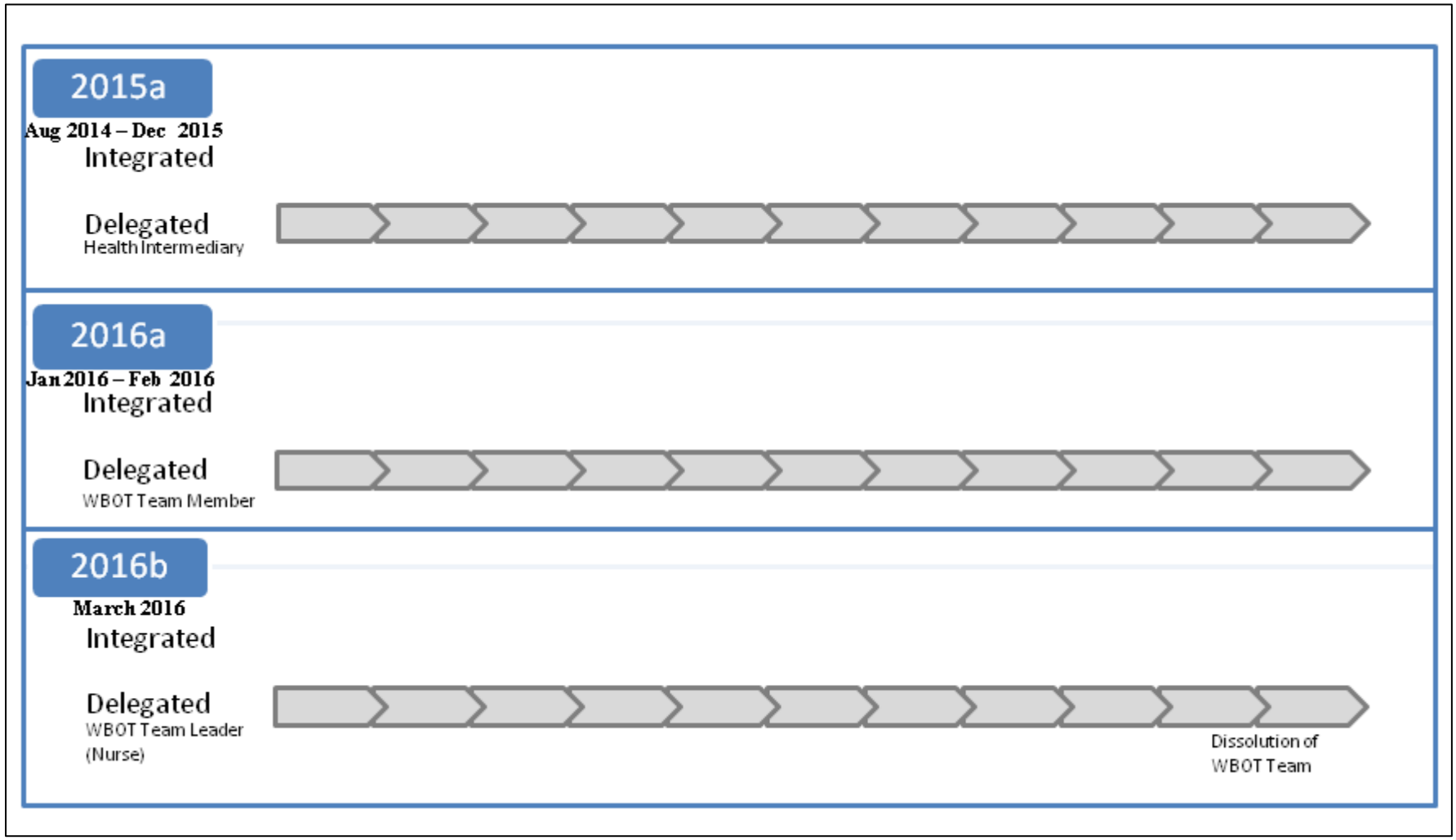


Figure 14 Registration Routines over Time at Clinic C (Researcher's Interview Transcripts and Observations)

5.3.4.2 Relationships

As in Clinic A and Clinic B, there was no evidence of efforts to actively build relationships between staff as part of the coordination of MomConnect registrations. Similar to the volunteers at Clinic B, the WBOT members were not enthusiastic about performing MomConnect registrations.

This lack of active building of relationships needs to be understood in the context of a public health system that was not functioning optimally, as evidenced by the lack of payment and subsequent dissolution of the WBOT.

5.3.4.3 Artefact-Based Coordination

Like Clinic B, proof of residence documentation was not required at Clinic C. As in the other two clinics, ID books or passports were required so that the relevant details could be captured in the MomConnect registration.

As in Clinic A an exercise book supplied by the clinic was used to capture the pregnant women's details in the initial presentation, the EDD was obtained from the ANC card where it was recorded by the nurse during the consultation, and the details were then ticked of once the registrations had been completed.

The cell phone handsets used were the personal handsets of the health intermediary (or WBOT leader) doing the registration at the time.

5.3.4.4 Unexpected Findings

Roles. Like Clinics A and B, Clinic C displayed the same temporary switching of roles in the mornings where health intermediaries and support staff worked together to manage the queues of clients until they had all received their files and been directed to where to sit, in the central seating area. This was observed on all days that observation was carried out in the mornings, and in both 2015 and 2016.

Over the period of the research I had developed a closer relationship with the health intermediary responsible for MomConnect registration in 2015 in Clinic C. I raised this issue of the temporary switching of roles with this heath intermediary while speaking informally on a day that I was visiting the clinic. The response I received was rather curt: "I am not a queue marshall"!

The significance that I developed for this response to my probing, and the one received at Clinic B when raising the same topic, is discussed in section 5.3.6.2.

Accountability. As in Clinic A, there was an awareness of and inclination towards community outreach. The health intermediary who performed all MomConnect registrations in 2016 was a health promoter, and was thus sometimes required to assist in outreach beyond the clinic:

"I (work in) health promotion most of the time, it is not inside a building, you have to be outside to reach those people out there." (Interview 16)

The WBOT that was assembled in 2016 was an expression of official support for community outreach. This researcher was encouraged to accompany the team (along with medical students from the University of the Witwatersrand) to visit community members living nearby, identify health issues, and encourage them to attend the clinic if they needed medication or other services that could only be delivered there. Fortunately I was able to join them.

There was a palpable sense of excitement among the team at the time.

Routines. The interviews and informal interactions indicated that MomConnect registration routines shifted with the availability of staff, were sometimes completed out of hours with the assistance of a partner, and it also seemed that sometimes registrations would fall through the cracks.

5.3.4.5 Summary

Like the other two clinics, MomConnect registration at Clinic C was driven by social coordination mechanisms.

In contrast to Clinic A and Clinic B there was much more variation in the registration routines, and who was involved in registrations. Clinic C was the only one where it was stated that registration routines were sometimes completed outside of working hours and the clinic building.

		MomConnect Registration Phase		
Clinic	**Type of Mechanism**	**Engaging**	**Gathering Information**	**Registering**
2015 Delegated: Routine 1	**Social**	**Roles:** Health intermediary gave a health promotion presentation to the pregnant women in a separate room	**Roles:** The ANC nurse identified the EDD in a private consultation	**Roles:** Registration was performed after the consultation by the health intermediary
	Relationships			
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File by ANC nurse	**Client file**: The EDD was identified from the file by the health intermediary **Personal Mobile Phone:** Belonging to health intermediary
2016 (a) Delegated: Routine 1 (WBOT member)	**Social**	**Roles:** Health intermediary gave a health promotion presentation to the pregnant women in a separate room	**Roles:** The ANC nurse identified the EDD in a private consultation	**Roles:** Registration was performed after the consultation by the health intermediary
	Relationships			
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File by ANC nurse	**Client file**: The EDD was identified from the file by the health intermediary **Personal Mobile Phone:** Belonging to health intermediary
2016 (b) Delegated: Routine 1 (WBOT nurse)	**Social**	**Roles:** Health intermediary gave a health promotion presentation to the pregnant women in a separate room	**Roles:** The ANC nurse identified the EDD in a private consultation	**Roles:** Registration was performed after the consultation by the health intermediary
	Relationships			
	Artefact-based	**Client File:** Collected by the pregnant woman at the Reception Desk	**Pregnancy Wheel:** Used to determine EDD. Recorded in Client File by ANC nurse	**Client file**: The EDD was identified from the file by the health intermediary **Personal Mobile Phone:** Belonging to health intermediary

Table 20 Coordination Mechanisms supporting MomConnect Registration Routines at Clinic C (Researcher's Interview Transcripts and Observations)

5.3.5 Between-Case Comparison and Key Findings

This research commenced with three research questions. These were, first, what are the coordination mechanisms evident in mHealth in the workplace? Secondly, how does the workplace- and broader cultural-historical setting affect this coordination? And, finally, how do the coordination mechanisms and setting influence the routines that develop? This between-case comparison draws on the findings to respond to each of these three questions, and integrates unexpected findings from the different sites to develop compelling evidence for additional coordination mechanisms as well as problematisation of one of the integrative principles.

MomConnect is an example of mHealth where, unlike is often assumed, implementation does not yield direct benefit to those responsible for making it work i.e. the nurses and health intermediaries. In addition, MomConnect registration was also not intended to transform or replace existing coordination processes. As a result when this study was designed MomConnect presented itself as a case that was particularly suitable for exploring how mHealth in the workplace occurs as coordination with existing practices, which by definition is expected to represent the longer-term situation of mHealth use (Romanow et al., 2018). As such this case is particularly suitable for gaining theoretical and empirical understanding of how mHealth may look when it becomes prevalent and institutionalised, rather than a novel way of undertaking work. It is also well suited to examining how the cultural-historical setting of public PHC clinics in South Africa may affect mHealth in the workplace.

Interviews and observation at the three clinics yielded a plethora of information which was analysed using a hybrid methodology. First the transcripts were coded employing descriptive and thematic approaches to explore the respondents' perceptions and priorities as they coordinated MomConnect in their daily work practices. Next the coded transcripts were revisited to reorganise the initial codes in terms of the categories and themes from the coordination studies perspective developed in this research (see Figure 1). The coordination mechanisms identified in this process were presented in Table 18, Table 19, and Table 20. These results were compared in summary in Table 21. Finally, changes in routines over time (represented schematically as timelines of integrated or delegated forms, and annotated with relevant events) were summarised in Figure 12, Figure 13 and Figure 14.

Section 5.3.5.1 discusses the significance of these findings for extant empirical knowledge and theory. Sections 5.3.5.1 to 5.3.5.3 compare and contrast the coordination mechanisms identified with current research, and section 5.3.5.4 summarises the implications for Research Questions One

and Two. Section 5.3.5.3 provides compelling evidence of how the cultural-historical setting influences the coordination of MomConnect registration through artefacts that connect it with the cultural-historical setting; addressing Research Question Two. Section 5.3.5.5 integrates the evidence from the coordination mechanisms with issues arising from the setting to argue how these influenced the different routines that developed. Section 5.3.5.6 summarises the implications for the challenge posed by Research Question Three.

5.3.5.1 Social Coordination Mechanisms

Roles: The analysis of coordination mechanisms at the three clinics revealed that the predominant mechanism at all of the clinics was that of role: the nurses assumed an authoritative role as the most highly qualified health professionals in the clinic. All accounts from the health intermediaries indicated that they carried out the nurses instructions on how to coordinate MomConnect registration, although others not interviewed resisted being involved.

The authoritative role taken by senior health professionals is in line with research on coordination in health care workplaces, and in work relationships in mHealth. One exception is the informal interactions between medical personnel in the course of emergency treatments, where lower-status staff might challenge the direction of doctors under extreme conditions (Faraj & Xiao, 2006).

The ANC nurses decided the form that the registration process should take: whether it was delegated for the health intermediary to carry out once the EDD had been calculated by the nurse in the consultation (Clinics A and C), or whether registration took place in a group with the pregnant women (Clinic B). Again, this is in line with what has been found in prior research.

Some mHealth research has identified distress among health intermediaries at the bounds set by health professionals on their use (or potential types of use) of the technology – see for example the unwillingness of midwives to call doctors using the cell phone they had been provided for communication because it was perceived as leading to resentment (Chib et al., 2008).

There is no evidence that there has been an open challenge from health intermediaries to the authority of health professionals in determining the form of mHealth coordination in the workplace. However, reluctance on the part of some health intermediaries to perform MomConnect registrations was noted at Clinic B by the ANC nurse, and of WBOT member at Clinic C by the most senior health intermediary.

This research contributes to empirical understanding an account of the different ways that the same mHealth technology is used in the workplace by different levels of staff; sometimes delegated in line

with established understanding, and sometimes contested by health intermediaries reluctant to take on this responsibility. Extant scholarship has not previously identified this phenomenon.

Routines: These differed between sites, but remained close to the officially recommended routines (see Table 15). What became clear from the field work was the variety of different health intermediaries that were involved in registration. Where the official routines mentioned only health promoters and data capturers as assisting nurses with the registration process, the field study also identified health intermediaries designated as Community Health Workers, volunteers and WBOT members. Analysis of the coordination of MomConnect registration identified volunteers (Clinics A and B) and WBOT members (Clinic C) as being involved at different times, to different degrees.

This differs from other accounts of mHealth, where it was provided to specific categories of health intermediary such as ASHAs (Mukherjee, 2015) or midwives (Chib & Chen, 2011), and no further changes in who was to use mHealth was identified. One of the contributions of this research to empirical understanding is the identification of shifts in the involvement of different levels of health intermediaries in workplace use of mHealth.

Sometimes MomConnect registration routines involved a health intermediary performing registrations outside of the physical location of the clinic, and outside of working hours (Clinic B) in contrast to the officially recommended routines. This is discussed in more detail in section 5.3.6.4.

Proximity: The clinics were relatively small buildings, and all available rooms were put to use. Staff all worked in close proximity to each other, facilitating communication. No evidence was identified that issues of proximity influenced the coordination of MomConnect registration. Where staff using mHealth move between formal health care workplaces and other locations (such as families in their homes), this may change.

5.3.5.2 Relationships

Relational coordination was broadened to the more inclusive category of relationships in the coordination studies perspective (see Table 4), as the literature on mHealth had identified that relationships between health care staff as well as between health care staff and clients was of importance in the coordination of care. The literature on relational coordination deals primarily with relationships between doctors or between doctors and nurses (Gittell et al., 2013). No report of this kind of behaviour was identified in the interviews; and neither was it observed. Most reports of MomConnect registration did not mention the influence of relationships.

One of the health intermediaries, rather like the ANMs described by Mukherjee (2015) (see 5.3.6.3), voiced a sense of being reduced to a set of hands to perform MomConnect registrations (see

5.3.2.3). Relational coordination is the building and nurturing of relationships as a way of improving coordination. This demand for compliance from the health intermediary without regard for their feelings as evidenced by their sense of diminishment represents a negative manifestation of relational coordination (Gittell, 2002). From the other perspective, staff who tried to delegate MomConnect registration to lower-level health intermediaries sometimes reported that they were unwilling to become involved in MomConnect registration (see 5.3.3.2 and 5.3.4.2).

What was more marked was the unprompted enthusiastic reporting of the importance of outreach to communities at Clinic A, in contrast to waiting for them to come to the clinic (see 5.3.2.3). This sense was confirmed when probed at Clinic C, where a WBOT was active during the 2016 field study. The implications of this for coordination in the clinic are discussed in 5.3.6.3.

5.3.5.3 Artefact-Based Coordination

The artefacts involved in the registration process showed no differences between the clinics; but different influences from the local setting were evident.

Client File: Clinic A required clients to present proof of residence in addition to the identity documents requested at each clinic. This was reported as enabling local residents to access the clinic due to the large number of people wanting to attend while passing through.

Informants at both clinics B and C reported that clients would move from one to another, and not disclose that they had already been tested for serious conditions (for example, HIV/AIDS). This distorts the power of the artefact to efficiently transmit information, as was intended. This kind of misreporting has been described in the literature as a way of trying to manage social identity and stigma in situations of unequal power relations (Stadler et al., 2015), which is a pressing issue in South Africa .

The client file that is referred to in the officially recommended MomConnect registration routines is thus a contested artefact in the South African setting.

Personal Cell Phone: Clinics A and C relied on health intermediaries using their personal cell phones to perform registrations. At Clinic B the clients were led through the registration process on their own cell phones. Informants from all clinics reported in 2015 that some clients were initially unhappy at the prospect of being registered for MomConnect; either because they were concerned that information they did not want disclosed would be reported or because they were concerned that their prepaid airtime (credit) would be used up.

In addition, one of the health intermediaries was responsible for almost all registrations at one of the clinics during the entire field study. This health intermediary was on a month-to-month employment contract, was unable to pay to repair their personal phone that had a badly cracked screen, and expressed distress that the health department did not provide a device.

The personal cell phone was thus not simply an instrument for performing registration. It was also a Janus-faced device (M. Arnold, 2003) that simultaneously carried sensitive personal information and the potential to disclose it; and that was bound up with social identity and vulnerability (Stadler et al., 2015) in a highly-unequal society.

5.3.5.4 Research Questions One and Two

Research Question One:

"What are the coordination mechanisms evident in mHealth in the workplace?"

Analysing the empirical evidence assembled in this research revealed a variety of coordination mechanisms, representing almost all the categories represented in the extant literature (see Table 4). The dominant coordination mechanisms were established roles and routines, already well acknowledged in health care research as being decisive. Plans and rules (e.g. formal responsibilities of different professions and occupations) showed no sign of overlap in the PHC clinics, and there was no evidence of negotiation or contestation of this mechanism. Further, neither relationships nor relationship building played a significant role in influencing coordination around MomConnect registration.

MomConnect registration involved a number of artefacts already in use in the ANC, such as the patient file and the pregnancy wheel. The role of these artefacts did not change with the introduction of MomConnect, which did, however, led to the introduction of the cell phone handset as a relevant artefact, and the associated issue of the boundary between the professional and the personal.

Importantly, however, where previous research has identified voluntary use of personal handsets for "informal" mHealth delivery (Hampshire et al., 2016), this research has revealed divergent responses by health intermediaries to the demands of an official initiative. Neither relationships nor relationship building played a significant role in influencing coordination around MomConnect registration.

This evidence that mHealth in the workplace is so heavily influenced by coordination with existing workplace arrangements demonstrates that the coordination studies perspective is a valuable counterpoint to the more established "transformational" approach to understanding mHealth.

Research Question Two:

"How do the workplace and broader cultural-historical setting affect this coordination?"

Analysis of the transcripts and observations revealed that these settings affected the coordination of MomConnect registration through the artefacts. The use of identification documents was meant to be a simple step in the registration routine. However clinic staff indicated that this step often raised an error, which they related to pregnant women who came from outside of South Africa. Their interpretation was that this arose from the use of falsified or borrowed identification documents, because migrants making use of PHC clinics in Johannesburg often do not have the resources to successfully navigate the formal residence application process. In this way the broader African setting impacted directly on MomConnect registration, which envisaged that all users would be compliant with formal documentation requirements.

The client behaviour of "shopping" between clinics also influenced care provision, because it led to duplication: staff had to open new patient files for clients who had already attended another clinic. Staff explained this behaviour related to a preference for less abrasive staff compared to other clinics, or clients evading previous diagnoses of serious health conditions (such as MDR TB and HIV/AIDS). mHealth design often implicitly assumes that clients have an association with a single health care facility only. However, the second explanation plus the high burden of chronic health conditions in South Africa undermines the basis of this assumption.

As this return to the findings shows, artefacts act as "carriers of context". This concept, coined by Heeks (2005) was originally used to describe the opposite movement: of the assumptions of software designers to local settings in developing countries. However, this research demonstrates robustly how the cultural-historical context is carried into mHealth coordination.

5.3.5.5 Influences on Routines

The coordination mechanisms identified above, and the effects of the wider clinic and cultural-historical setting, provides compelling evidence that these both shaped the routines of MomConnect registration. First of all, the dominance of social roles in the clinics led to registration routines that were typically performed by health intermediaries, although ANC nurses were involved in registration in all cases according to the interviews and transcripts from Clinic C (see Figure 14).

Reluctance from health intermediaries at Clinic B led to the ANC nurse training administrative staff to perform MomConnect registration, while retaining responsibility for providing general health promotion and ANC consultations. At Clinic C this reluctance on the part of some of the WBOT members meant that MomConnect registrations were not performed by one person on a regular basis, but were shared out between the senior health intermediary, the WBOT leader and WBOT members who could be persuaded to help out.

This empirical evidence contributes the first systematic description of how nurses assign responsibility for mHealth in the workplace, the resistance of some of the health intermediaries who occupy a more junior position in the clinics and the consequent variation in routines over time. This tension between delegation and resistance is important to inform successful mHealth practice on the one hand, and illuminates an aspect of coordination in the health care workplace that has not been documented previously.

The enthusiasm of heath intermediaries for greater involvement with community outreach, preparedness to perform MomConnect registrations out of work hours and at home suggests that despite the resistance of some to involvement with MomConnect there may well be more willingness to take this work on outside of the clinic (see 5.3.2.4 and 5.3.4.4). This theme is explored in more detail in 6.1.2.

	Clinics		
Registration by Year	**Clinic A**	**Clinic B**	**Clinic C**
Registration 2015	The health intermediary was responsible for all phases of the registration routine except the determination of the EDD (ANC nurse consultation)	The ANC nurse coordinated joint registration sessions with the assistance of a health intermediary	The health intermediary was responsible for all phases of the registration routine except the determination of the EDD (ANC nurse consultation)
Additional Comments			
Registration 2016	The health intermediary was responsible for all phases of the registration routine	A contract nurse was responsible for all phases of the registration routine in the first quarter of 2015. The ANC nurse trained other health intermediaries to assist in joint registration	The health intermediary from 2015 was given additional responsibilities in 2016. Attempted to delegate responsibility onward. Uneven success
Additional Comments	Incorporation of MomConnect health intermediary into newly formed WBOT in 2016	Unwillingness to be involved from volunteers in 2016	Unwillingness to be involved from WBOT. WBOT disbanded at the end of the 2016 fieldwork
Overall: **Unexpected Findings**	o Queue management by support staff o Community outreach as an activity for expansion by health intermediaries	o Queue management by support staff	o Queue management by support staff o Community outreach as an activity for expansion by health intermediaries (WBOT to register pregnant women in the community) o MomConnect registration being performed outside of clinic hours and by family members at times
Comments	Neither the clinic manager nor the health intermediary were clear as to who could do MomConnect registrations after the move to WBOT		Unclear who could do MomConnect registrations after the dissolution of the WBOT

Table 21 Comparative Overview between Clinics of Coordination Mechanisms in MomConnect Registration (Researchers data)

5.3.5.6 Research Question Three

Research Question Three:

"How do the coordination mechanisms and setting influence the routines that develop?"

Table 21 above summarises coordination mechanisms at the three clinics, the changes between the two rounds of field work and the unexpected findings at the different sites. Taken together with the changes in routines over time and key events (see Figure 12, Figure 13 and Figure 14), the field work strongly suggests that routines shift in relation to the power of staff to delegate to lower-status individuals (relative roles). In the case of Clinic C registration was first performed by the health promoter, later by the WBOT, and then again by the health promoter when the WBOT disbanded. At Clinic B, registration was first performed by the pregnant women themselves under the supervision of a health intermediary. According to the ANC nurse involved the health intermediaries resisted involvement in the registration process, and a contract nurse was performing the registrations by the time the next field work was undertaken.

The coordination mechanism of roles thus clearly influences the routines that develop, and their change over time. In addition the cultural-historical setting, and particularly the changing organisation of health intermediaries (e.g. the formation of WBOTs) also directly impacts on routines of mHealth coordination, as the pool of lower-status staff changes.

5.3.6 Interrogating Unexpected Findings

The findings discussed in the previous sections used a perspective on coordination (see Figure 1) to analyse the data according to these concepts. The cross-case comparison in 5.3.5 integrated findings from the different cases; including a number which could not be explained using this framing. This section describes the constructs that emerged after reflection on these findings together with the literature in a process of abduction (Charmaz, 2014; Sarker et al., 2018; Timmermans & Tavory, 2012).

Timmermans and Tavory (2012) make three methodological recommendations in order to assist this process (see 4.4.3): revisiting the data; putting aside existing understandings of the data to make space for creative interpretation (defamiliarisation) and considering what other theoretical frameworks might suggest in trying to understand the phenomena (alternative casing). This analysis draws on the principles developed by Klein and Myers (1999) (see Table 5) to help guide the revisiting of the data and defamiliarisation, and the subsequent identification of novel concepts.

The principle of the hermeneutic circle is used as the fundamental guide to revisiting the data and defamiliarisation, as it encourages a reflective process moving between the meaning of the elements of the phenomenon and the meaning it holds as a whole. The principle of contextualisation is used to inform the reassessment of how the interviews and observations at the clinics fit with the broader cultural-historical setting of PHC in South Africa. Finally the principle of abstraction and generalisation is used to guide a move from what was identified from transcripts and observations to a level where it results in transferable insights that inform and extend existing theory.

Because this is an interpretive study, and concerned with the perceptions and practices of the informants, abstraction from the data to a more abstract level introduces concepts that describe the perspective of the informants. The data were first subjected to alternative casings following the principles of abductive analysis (Timmermans & Tavory, 2012) to identify whether other theoretical framings might explain the unexpected findings. Novel concepts were proposed based on creative inferences and induction when these alternative casings were unsuccessful.

The three novel concepts are discussed in the following sections. Two of these concepts describe coordination mechanisms that have not previously been identified, either in the mHealth or wider health workplace literature. The third concept is in direct opposition to the integrative principle of accountability identified by Okhuysen and Bechky (2009), and thus problematises the assumptions of the coordination studies perspective (Alvesson & Kärreman, 2007). See also section 4.2.5.

5.3.6.1 Alternative Casing

The case study data was subjected to alternative casing (Timmermans & Tavory, 2012) using other theories, in order to identify whether the these might explain the unexpected findings. These attempted casings were all rejected as described below; buttressing the claim that these findings may best be explained in terms of novel phenomena that contribute to extending the coordination studies perspective.

Structuration theory (Giddens, 1984; Jones & Karsten, 2008; Ling et al., 2018), Actor-Network Theory (ANT) (Andrade & Urquhart, 2010; Latour, 2007; Walsham, 1997) and Activity Theory (Engeström, 1995; Kaptelinin & Nardi, 2012; Karanasios & Allen, 2014; Korpela et al., 2004) are all widely used in IS research and are briefly discussed below, together with their relative strengths, limitations and the insights that might have been garnered from them in relation to mHealth coordination in the workplace as represented by MomConnect registration. This is a form of “alternative casing”, as suggested by Timmermans and Tavory (2012, p177).

Structuration Theory. Structuration Theory is a high-level sociological approach suggesting how individual human choices draw on social rules and resources, leading to patterns of routine activity that in turn become institutionalised (Jones & Karsten, 2008). This theory aims to integrate insights from different sociological traditions, spanning from the individual to the societal level (Giddens, 1984). It emphasises that human beings are always able to make choices, despite the institutional constraints under which they operate. Structuration Theory was used in early interpretive studies of IS appropriation to develop a richer understanding of how human choices influenced IS use, and subsequent organisational implications (Barley, 1986; Orlikowski & Robey, 1992). One of its strengths is that it provides tools to analyse how new ways of coordination and communicating can come to be accepted. It can be used across different scales, from workplaces up to organisational levels, all of which are important to understanding mHealth.

Structuration theory has only recently been introduced to the study of mHealth (Ling et al., 2018). In Ling et al (2018), structuration theory was used to explain the development of informal, mobile phone-based communication processes as the appearance of a new set of rules and resources, potentially leading to institutionalisation. The new channels of communication being established by MomConnect between clinic managers and district managers (see 5.3.5) might, in time, show similar characteristics. The establishment of these new modes of communication, increased frequency of contact between district and clinic managers, and subsequent changes in relationships could be explored using Structuration Theory (e.g. (Ling et al., 2018)). At the time of the fieldwork, both clinic managers and ANC nurses were probed regarding feedback from MomConnect from district management. None reported regular communication on these issues, but this could change over time, something a longitudinal study might uncover.

Since the fieldwork did not reveal such new modes of communication but instead showed relatively minor changes to coordination and communication Structuration Theory was rejected as an alternative theoretical framing.

Actor Network Theory. In contrast to Structuration Theory, ANT gives equal weight to the agency of human actors and non-human actants, and emphasises the importance of “following the actors” (and actants) when undertaking an ANT analysis (Latour, 2007). ANT was developed to explain the spread of scientific innovations by accounting for the networks responsible for the forms these innovations took (Latour, 1987, 2007). ANT has gained attention in IS research because it holds the promise of accommodating the specific characteristics of the IS artefact in interaction with social context, and supports empirical research (Doolin & Lowe, 2002; Walsham, 1997). Nevertheless, reservations have been expressed about its usefulness, because such studies may end up focussed

on local arrangements, and neglect broader social structures and their influences (Mitev, 2009; Walsham, 1997). ANT is a theory with a wide scope and wide potential applications. It is particularly suitable for analysing how innovations come to be accepted, taking into account stakeholder attitudes and motivations as well as technological features. Thus it would offer a route towards understanding how case studies of mHealth came to be accepted by different stakeholders with interests in seeing the technology developed in different ways. (*See for comparison* Latour (1996)).

Assigning equal weight to human and non-human actors is a powerful device for uncovering how human choices and material affordances interact, for example by demonstrating how experimental science relies on improved instrumentation to resolve conflicting evidence (Latour, 1987). However, ANT is more useful in explaining how a specific situation arose than in examining unfolding situations characterised by dynamic change.

ANT could thus have utility in studying how the MomConnect project came to be implemented: examining who initially promoted the concept; how others received it; and how the technology developed and changed through this process. It could also have utility at clinic level, examining how district and clinic managers came to use information generated by MomConnect over time and how this was influenced by the specific capabilities of the technology. At the time the field study was conducted, there was minimal feedback between district- and clinic managers, but this could present a topic of enquiry going forward.

ANT was rejected as an alternative casing of the field study as it revealed a rapid and minor shift in coordination within the clinics, rather than a contested process of acceptance that ANT could have explained.

Activity Theory (AT). Activity Theory addresses the interrelationship of human agency and tools (technological or otherwise) in a social context. Thus it is a more specific and focussed approach than either Structuration Theory or ANT on IS coordination and the nature of the IS artefact. Activity Theory has a wider range of possible applications (Karanasios, 2014) at different scales. It has robust utility in supporting analysis of technology use in the workplace, where it offers a structured way to analyse the interaction of specific technological features with existing workplace practices.

The most fundamental concept in AT is that of goal-oriented activity (Kaptelinin & Nardi, 2012b; Korpela et al., 2004; Vygotsky, 1978b). An activity happens when a subject (a person or group of people) interacts with an object using a tool, in a social context (Kaptelinin & Nardi, 2009). The tool "mediates" the interaction of the subject with the rest of the activity system in the terminology of AT,

and as a result the characteristics of the tool and the way it is used are important to the development of the activity system over time (Kaptelinin & Nardi, 2009).

The form of AT most familiar to the IS research community is that proposed by Engeström, whose work is briefly introduced below to contrast it with the approach this research adopted.

Engeström (1999) proposed an expanded version of AT that includes the concept of community together with the subject, object and tool originally present in AT, in order to apply it in an organizational context. He proposed a conceptual model, the Activity System Model (ASM), that has found wide acceptance in the AT community (Victor Kaptelinin & Nardi, 2006). Engeström separated out aspects of the social world offering resources for activities in his ASM, as shown in **Error! Reference source not found.** below.

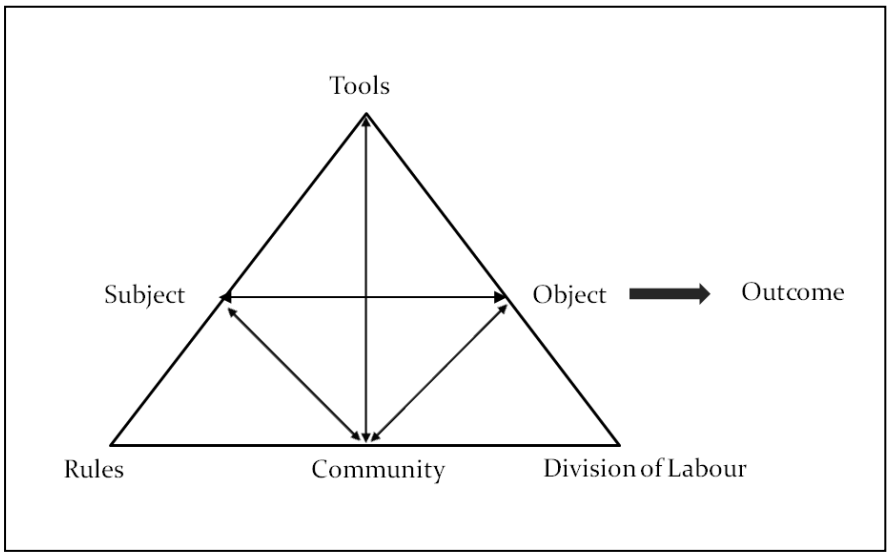


Figure 15 The Activity System Model (Engeström, 1999)

AT offers a structured way to analyse the interaction of people with technology in the workplace via the use of the Activity System Model. MomConnect registration could be conceptualised as a process of clinic staff (the Subject), making use of MomConnect (the Tool) to register pregnant women (the Object) leading to improved maternal and child health (the Outcome), as illustrated by Wolff-Piggott, Coleman, and Rivett (2017).

Because the registration of pregnant women for MomConnect is technically very simple, and led to only minor changes in ANC coordination between nurses and health intermediaries, the Activity System Models before and after MomConnect implementation would be virtually unchanged. As a result AT analysis can reveal relatively little from the case of MomConnect. Additionally, Activity Theory conventionally assumes that technology use is a focus of workplace practices, where in mHealth it is often designed to be as unobtrusive as possible. It was therefore rejected as an

alternative theoretical casing. Nevertheless, it could be useful in investigating the relationship between pregnant women and the MomConnect messaging system as they navigate their way through pregnancy. It would also offer an alternative approach for analysing more complex mHealth solutions entailing ongoing interaction between different staff e.g. a setting such as the exchange of information between nurses at different clinics and a central laboratory (Kumar et al., 2015).

Thus employing other theoretical frameworks, as outlined above, in researching mHealth could help shed light on important but underexplored issues in mHealth, for example, how the technology is institutionalised (Ling et al., 2018), the organisational implications of the development of new mHealth-supported lines of communication (Asangansi, 2016) and how work practices change when different occupations start communicating via mHealth (Kumar et al., 2015).

However, this research adopted a coordination studies perspective because the contribution aimed for was an understanding of how a technology fits in with existing routines.

5.3.6.2 Coordination Mechanism: Role Flexibility

Clinic staff of different designations (excluding nurses) worked together temporarily every day to coordinate the management of clients queuing for their folders in the morning. Once all the clients had received their files, the staff would return to the tasks associated with their formal positions. This occurred at all of the clinics under study, and was observed every day that observation took place (researcher's field notes) – see Table 21. This departure from formal roles and responsibilities was at odds with the manager's insistence on being bound by the organogram for Clinic A (see 5.3.2), and general understanding of the nature of bureaucratic organisations where roles are clearly defined and rigid.

This phenomenon was first observed in the observation sessions in 2015. It did not fit in with any of the coordination mechanisms identified in extant literature, whether in health care or more generally. The field work in 2016 was used to identify whether this process was still evident, to confirm that it was not a result of conditions that had been prevalent in 2015 that I was not aware of. Observations in 2016 identified that this phenomenon was still present.

The phenomenon was probed with informants at Clinics B and C where I had closer relationships with more senior staff, and the confidence to query an arrangement that did not fit with any description that I had received from informants in interviews. Both indicated obliquely that this was an implicit arrangement that was well established (see 5.3.3.4 and 5.3.4.4), although not officially approved.

The phenomenon was clearly institutionalised, despite departing from the formal responsibilities. It was associated with the roles that people held i.e. office staff excluding the nurses. Once the need to organise the queues was over, these staff returned to their usual roles and physical locations. The health intermediary at Clinic C that I had raised the issue with in passing had commented that he was not a "queue marshal". As a result I followed this up and identified that "queue marshall" is an official position in hospitals, where the role of this person is to "control and maintain order in (the) patient waiting area", and "managing and controlling queues" (Jobstown.co.za, 2017).

The phenomenon as exhibited by the staff who participated in it was thus termed "role flexibility". The empirical and theoretical implications of this phenomenon and concept are discussed in 6.1.1.

5.3.6.3 Integrating Condition: Multiple Accountability

Health intermediaries at both Clinic A and C volunteered their involvement in community outreach activity, and enthusiasm for increasing this aspect of their jobs (see 5.3.2.4 and 5.3.3.4). Some of these health intermediaries were also responsible for MomConnect registration. An increase in community outreach had been government policy for almost a decade at that time (Clarke et al., 2008), but progress had been noted as uneven by several author (Maureau, 2014; Mottiar & Lodge, 2018; Schneider et al., 2018) and it was thus unexpected that it would be encountered in the clinics when it was not an expressed interest of the researcher.

The MomConnect training material on registration routines (RMCH, 2014) presented MomConnect as occurring only within the confines of the clinic. MomConnect has been designed to enable health intermediaries to register pregnant women as part of community outreach (outside of the clinic) and without any consultation with a nurse (National Department of Health: Republic of South Africa, 2014b). This was, however, accompanied by the caveat that the messages from MomConnect would be limited until a full consultation with a nurse at a clinic had taken place, and all necessary information (especially the EDD) had been entered.

In talking to the health intermediaries it became clear that MomConnect registration in the clinics was experienced as an additional burden to existing routine coordination. Without being prompted a number of them expressed enthusiasm for becoming engaged in community outreach (see 5.3.2.1, 5.3.3.1 and 5.3.4.1). Although not all health intermediaries were aware of the potential of MomConnect registration as an option outside of the clinic, they all shared a sense of accountability not only to the clinic, staff (nurses) and clients there, but also strongly to clients as people in the community who could be reached through outreach outside the clinic walls.

The coordinating studies perspective uses accountability to describe a quality of relationships within the organisation. The sense of accountability held by the health intermediaries was at odds with this conception. The health intermediaries were not in a position where they could change their scope of work. They were reliant on the nurses to initiate or sanction such a change. Some of them were aware of the policy changes suggested by the national department, but their enthusiasm was not tightly linked to job progression or even a greater degree of autonomy from the clinic. It was an outwardly-directed impulse.

This unprompted enthusiasm of the health intermediaries was an orientation rather than a coordinating activity. Reflection on these unexpected findings in the context of health policy in South Africa more broadly suggested that the health intermediaries were self-motivated beyond simply following directives from the nurses in the clinics, with a sense of purpose and solidarity with the broader community that they wished to serve.

This phenomenon was named multiple accountability as it was present as an integrating condition of coordination (see Figure 1), but it was oriented not only towards other staff in the clinic but also outwards to the community, and not only as potential clients.

5.3.6.4 Coordination Mechanism: Covert Routines

The case analysis described the various routines by which MomConnect registration was carried out and the coordination mechanisms evident in each routine (see Table 19, Table 20 and 21). These routines changed over time as members of staff came and went, and as health intermediaries changed the scope of their roles within the clinic. Over time this researcher became more familiar with the health intermediaries responsible for MomConnect registration and gained more insight into the part of the MomConnect registration routine that they performed

These informants revealed that the routines described in interviews did not correspond precisely with the routines that actually took place. In particular, constraints on the time available during formal clinic working hours, and the delays caused by the dropped USSD sessions, meant that MomConnect registrations were completed in non-standard ways.

These kind of routines identified at clinics included taking registration information home and performing registrations out of hours (see 5.3.4.4), or fitting registrations in within working hours between other existing obligations over an extended period of time rather than carrying them out on the day that the data as collected (see 5.3.2.4). While never stated overtly, health intermediaries implied that there were times when registration could not be completed because of the unanticipated demands on their time that arose every day.

Covert routines emerged as different ways of handling those demands of MomConnect registration that could not be accommodated in clinic routine. One category of covert routine consisted of drawing on personal resources to accomplish MomConnect registration e.g. performing registrations out of hours, at home and sometimes with assistance from other members of the household. Another category of covert routine was not detailed explicitly but emerged from questions that were posed but not answered directly. This category may be described as 'registration as coping' – where every registration was not necessarily completed successfully but where it was balanced against the imperative to address the range of necessary tasks adequately rather than perfectly. Both clinic managers and support staff implied that MomConnect registration was not the highest priority for the clinic, and that registration could suffer at times when personal attention to the expressed needs of clients was prioritised.

Given that these routines were not compliant with officially sanctioned processes they were not made visible to supervising staff members. They are thus termed covert routines. As noted in the previous section, the Health Promoter at Clinic C sometimes took the registration details home so that they could be entered after hours when the work could not be delegated. The volunteer at Clinic A had no option of delegating the work of registration. The work of registration was thus doubly invisible, both to the nurses who delegated it and only lightly monitored it, and to the district authorities.

The significance of covert routines is discussed in 6.1.3.

5.3.7 Summary

This section has drawn on the field study to analyse and compare the coordination of MomConnect registration at each clinic. This provided compelling evidence to answer the research questions, and in addition to identify three novel concepts from unexpected evidence. The implications of these findings and novel constructs are further discussed in Chapter 6.

5.4 **Coda**

I'm finishing an interview with one of the clinic managers. I've been probing around the issue of resource constraints and MomConnect implementation. She has for the first time expressed frustration with the process where district management plans changes at the clinics and expects them to be implemented with no increase in resourcing. "I wish I had that job (in planning)", was her acerbic comment.

The clinic is quieter now that it is afternoon. I seat myself in the corner of the clinic, keeping an eye on the flow of clients and the movements of staff. The clients still waiting are largely those waiting for their chronic medication; the pregnant women and those with young children needing vaccinations have been attended to. This clinic is situated in an area where clients may come from nearby housing as well as their place of work. The staff have several times mentioned that they have communication problems with people who do not speak any of the South African languages. I noticed several women with headscarves this morning, some of which were the traditional "doek" but others seemed that they might be religious. The latter would be more likely to be from further north, possibly from Senegal. While most of the clients were black there were scatterings of people of all colours, those reliant on public health services and unable to access expensive private medical care.

A woman in a white coat leaves a small office close by, and walks towards me on the way to the door. She asks what I'm doing there, and I reply that I'm a student doing observation. I ask what her position is and she explains that she is a psychologist who comes in weekly to give counselling. I've never come across someone in this role before, and it seems that the clinics are seen as a resource to be drawn on by people who are unable to access overstretched social services staff from the Department of Social Development.

Suddenly three people come in through the clinic doors with the still body of a young woman. They call urgent questions, and then carry the woman through to one of the nurses' offices. There is a scurrying of staff moving in and out of the office. Afterwards I ask one of the nurses and I'm told that the woman had taken herbicide and needed urgent treatment to save her. There is a hospital in the area but the clinic is the first port of call for people who don't have private transport, as the ambulance service is known to be unreliable. In any case public hospitals are notorious for having long queues even for emergency patients.

...

About an hour before closing time one of the general workers comes in with a mop, as she moves through the clinic. The chairs that are no longer in use are stacked to the side, and those of us who are still seated move to make room for her to do her work. The clinic needs to be ready for opening tomorrow as a new set of clients stream in all over again...

Chapter 6 **Discussion**

Chapter 5 laid out and analysed the field study findings concerning coordination mechanisms. This chapter begins by exploring in more detail the novel and anomalous issues that emerged, and the way these foregrounded some limitations of current coordination studies. The chapter proposes extensions to our understanding of coordination to account systematically for these anomalies, and discusses the extent to which these extensions may be applicable in other settings.

Figure 16 below presents the framework developed in Chapter 3 to guide the research design and case analysis. Coordination mechanisms are grouped into the analytical categories of Social, Artefact-based and Relational. These mechanisms become effective to the extent that they support the development of the three integrating conditions: Accountability, Predictability and Common Understanding.

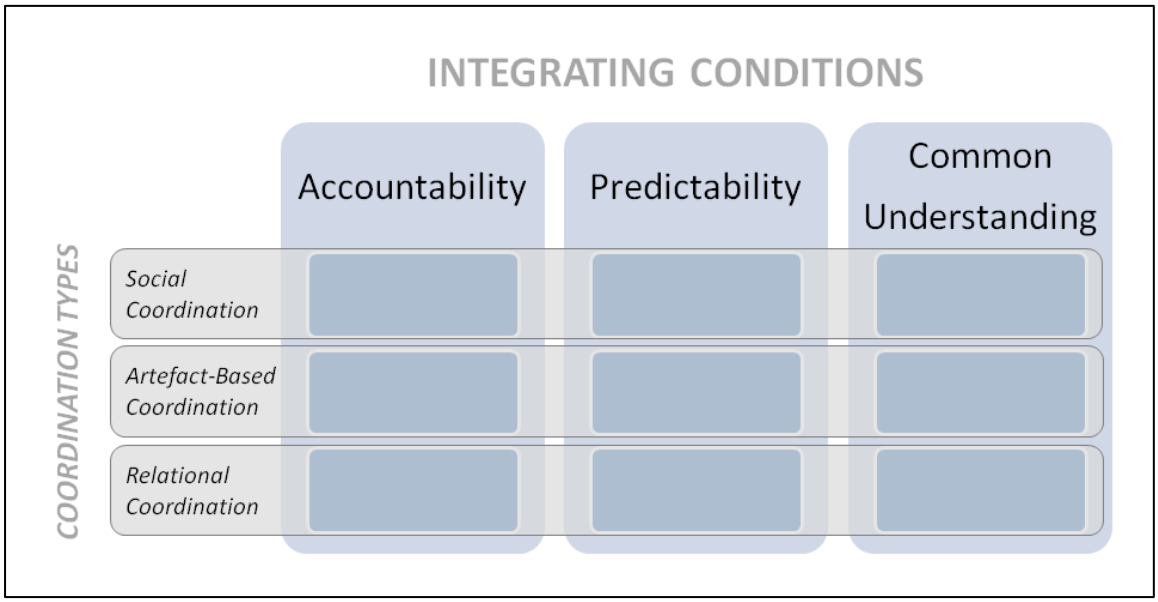


Figure 16 The Coordination Studies Perspective used in this Research (see Figure 1)

6.1 **Extending the Coordination Studies Perspective**

The case analysis demonstrated how the clinics under study studied operated in terms of the coordination mechanisms of health workplaces identified in Chapter Three. However, the data demonstrated deviations from what extant literature notes: in particular, in the emergence of important phenomena of role flexibility, multiple accountability and covert routines. These unexpected findings were reconsidered through a process of abduction (Charmaz, 2014; Timmermans & Tavory, 2012) and these higher-level concepts were derived based on this analysis. These concepts are summarised in Table 22 below.

Novel Concept	Type of Process	Description	Significance
Role Flexibility	Coordination Mechanism	Health intermediaries and support staff leave their prescribed roles to temporarily assist in the admissions process each day (checking for required documents, directing clients to the correct part of the clinic and generally managing queues)	Roles in health care (and especially in bureaucratic environment) are well-defined with little overlap (Bourgeault & Mulvale, 2006; Stisen & Verdezoto, 2017; A. Strauss et al., 1985). Role flexibility contradicts this consensus.
Multiple Accountability	Integrative Condition	Health intermediaries displayed a sense of accountability to both the clinic and to the broader community. Aspired to increase the amount of time spent in direct outreach to the community rather than work in the clinic. This sentiment aligned with broader PHC re-engineering policy even though it was not being actively implemented.	Coordination studies assumes that coordination orients staff to work to a common organisational goal and does not include goals external to the organisation (Okhuysen & Bechky, 2009). Multiple Accountability thus problematises (Gkeredakis & Constantinides, 2019) this aspect of the perspective on coordination.
Covert Routines	Coordination Mechanism	Health intermediaries responsible for MomConnect registration completed registrations outside of office hours and off the clinic property.	Routines in health care are intended to regulate how people coordinate their work in the work place and inside office hours. MomConnect registration was designed to meet these criteria. Covert Routines contradict this assumption because they took place outside of the work environment.

Table 22 Novel Concepts Emerging from Abductive Analysis (see 5.3.6) (Researcher's Data)

Two of these constructs, role flexibility and covert routines, are novel mechanisms that form part of Social Coordination. The third, multiple accountability, represents a disruption to the integrating condition of Accountability and therefore problematises (Gkeredakis & Constantinides, 2019) the coordination studies perspective. Multiple accountability describes the orientation expressed by health intermediaries from their sense of being accountable both to the clinic and directly to the broader community.

Refining and exploring the implications of these concepts involved revisiting the literature (Andrade, 2009) to confirm that they are indeed of broader theoretical relevance. This entailed an analytical recursion: revisiting papers with a set of questions different to those posed during the initial review of literature as well as exploring literature that had initially appeared tangential. Where this occurred it is flagged in sections 6.1.1, 6.1.2 and 6.1.3.

The coordination studies perspective developed is underlaid by assumptions derived from the setting in which it was originally developed: large private corporations in the manufacturing sector (Okhuysen & Bechky, 2009). Some of those most relevant to this research are that the organisation has clear boundaries and goals, that staff have clearly defined responsibilities and that they receive stable appointments. The following exploration of the conceptual findings interrogates these assumptions.

6.1.1 Role Flexibility

This research developed role flexibility (5.3.6.2) as a conceptual category encompassing how clinic staff of different designations (excluding nurses) worked together temporarily every day to coordinate the management of clients queuing for their folders in the morning. As noted, once all the clients had received their files, the staff would return to the tasks associated with their formal positions. This departure from formal roles and responsibilities was clearly institutionalised, despite departing from the clearly delineated formal responsibilities on which a bureaucracy normally rests.

Role flexibility is defined as a coordination mechanism that appears as a temporary, regularly occurring shift in roles of junior staff in the hierarchy away from formal designations in order to expedite customer-facing work in a bureaucratic workplace. It is characterised by the staff returning afterwards to their official roles. This mechanism does not result in a change of position within the organisation. Role flexibility departs from the established definition of a role in the coordination studies perspective because a role is conceptualised there as fixed and linked to a particular position in an organisation.

The role flexibility this research identified can be distinguished from the various informal activities of staff to support coordination described as articulation work (Schmidt & Bannon, 2013; Schmidt & Simone, 1996; Stisen et al., 2016). Articulation work is required on an ad hoc basis to ensure that any of a range of tasks are effectively coordinated. By contrast, role flexibility occurs regularly and is aimed towards the accomplishment of specific tasks.

The coordination studies perspective employs the construct of the role to explain what staff can expect others to contribute to achieving a particular goal. In other words, a formally defined role is

expected to promote monitoring of, and a common perspective towards, coordination (Okhuysen & Bechky, 2009). The concept of role flexibility was developed in a research setting where professionals (nurses) and non-professionals (health intermediaries) work together in the process of coordinating. Drawing on the research field work, it contributes insight about how the integrative conditions of accountability and common understanding can be met through temporarily shifting the scope of certain roles rather than maintaining them as fixed. The concept of role flexibility offers robust applicability in other settings where similar conditions prevail.

Identifying the novel construct of role flexibility has implications for theory as well as practice. Role flexibility as it is identified in this research has not been documented in extant literature. Revisiting this literature keeping the issue of role flexibility in mind highlighted that it is largely concerned with the relationship between health professionals at the same level (Randell et al., 2011), or between doctors and nurses (Allen, 1997; Bourgeault & Mulvale, 2006; Pine & Mazmanian, 2017). The few studies that have investigated workplaces where health professionals and lower status workers coordinate (Bossen & Foss, 2016; Stisen & Verdezoto, 2017) have been conducted in hospitals or private practices rather than clinic settings. The one study that was discovered on systematic change in the roles of doctors, nurses and other health professionals (e.g. dieticians and mental health counsellors) was identified in the management literature (Reay et al., 2016). Health intermediaries were not represented in this literature.

Role flexibility thus represents a novel phenomenon that is transferable to other health workplaces where both professionals (doctors or nurses) and less trained health intermediaries work together. Its presence suggests strongly that considering formal roles and articulation work as the only or dominant forms of social coordination in more diverse health workplace settings may well be inadequate. In addition it may also be transferable to other hierarchical, bureaucratic and resource-constrained settings.

At the level of practice, the concept of role flexibility has implications for both the design and implementation stages of mHealth. Different coordination approaches to mHealth implementation may be demanded by workplaces where health professionals work together with health intermediaries, as opposed to sites housing only health professionals or only health intermediaries.

6.1.2 Multiple Accountability

The coordination studies perspective assumes that the division of roles and responsibilities between staff members is well-defined, and that there is a clear sense of accountability to one another in jointly accomplishing interdependent tasks (Okhuysen & Bechky, 2009). Multiple accountability as it

emerged from this research breaches this framework (see 5.3.6.3). It describes how health intermediaries experience coordination as something that needs to be oriented beyond the clinic and towards the broader community, while the official structures to enable this (National Department of Health: Republic of South Africa, 2011) remain only in the process of being implemented (Schneider et al., 2018).

Multiple accountability is defined as an integrative principle that explains how volunteers or precariously employed people experience their socially-beneficial work. Specifically, it describes their sense of accountability not only to their managers but also to the communities or groups that they serve. In this research it was evidenced particularly in their enthusiasm to work directly with the community via the WBOTs, even though the WBOTs offered little employment stability or benefits. It is particularly remarkable because it contrasts strongly with extant studies of precarious work, which emphasise the sense of lack of choice experienced by employees (Arnold & Bongiovi, 2013; Han, 2018; Kalleberg, 2009).

Revisiting the literature on "informal mHealth" (Hampshire et al., 2016) and examining the content of transcribed interviews with nurses and health intermediaries, this research foregrounds the broader relevance of the concept of multiple accountability (see 3.2.2) i.e. as staff relate to clients in ways outside of officially recognised terms of engagement (Anstey Watkins et al., 2018; Hampshire et al., 2016; Ling et al., 2018). In the case described by Hampshire *et al.* (2016), clinic staff started using their own phones to assist clients when there was no official support for mHealth. Their sense of accountability to clients (over and above their formal obligations in the clinic) led them to implement "informal" mHealth. Irrespective of their clinic salary and official position, this was explained as:

"We have taken an oath to serve no matter the circumstance. [...] We feel we owe a duty to serve people" (Hampshire et al., 2016, p.39).

Mukherjee (2015) discussed another Assistant Nurse Midwife (ANM) in India involved in registering pregnant women and children under the age of five using mHealth who reported to staff at a local clinic. The ANM argued that her responsibility towards the clients was wider than simply that of numbers of registrations and had included the discussion of complex cases with a doctor at the clinic but:

"We have been dealing with pregnant women and children since I joined service (which was 30 years now). We always discussed cases at the (clinic) with the doctor about cases which we think to be high risk in our monthly meetings ... But for three years now our monthly meetings are only about

percentage of names registered ... We do not discuss cases, data or work plan anymore" (Mukherjee, 2015, p.661)

This research and the literature cited above clearly show that health intermediaries hold values of solidarity with the community that lead them to make use of their own financial resources and time to care for people in the community over and above what is supported by the formal institutions that they work for. It is also linked to a desire to widen the scope of their work and improve their skills. This does not fit with the instrumental logic of accountability to colleagues in a formal organisation that is assumed in the coordination studies perspective.

The concept of multiple accountability matters because it points towards a limitation in the coordination studies perspective. Coordination has been used for some time as a fruitful perspective for understanding the work of doctors and nurses in health care institutions (Faraj & Xiao, 2006; Pine & Mazmanian, 2017), based on the clear lines of accountability between different team members and a focus on a common task to be performed within the physical boundary of the building. Multiple accountability in mHealth, as identified in the PHC clinics under study as well as in the broader mHealth literature, suggests to the contrary that accountability (as experienced by the health intermediaries) is oriented both to work colleagues and to the wider community. In other words, health intermediaries do not need to have a formal responsibility for community outreach assigned to them in order to experience and act on this accountability, as has been identified in studies of informal mHealth and of health intermediaries more generally. The literature on front-line public service delivery provides evidence that the concept of multiple accountability is also relevant across a range of non-health related frontline service delivery organisations (Hupe & Hill, 2007; Lipsky, 2010).

The concept of multiple accountability has importance for both theory and practice. It problematises the coordination studies perspective (Gkeredakis & Constantinides, 2019) by challenging a fundamental assumption: that organisation members experience accountability first and foremost as accountability to others within the same organisation (Okhuysen & Bechky, 2009). This tension between established theory and empirical findings strongly suggests that the applicability of the coordination studies perspective may weaken in settings where doctors and lower status professionals work together promoting community-oriented care, for example, during the move to inter-disciplinary PHC teams in Canada (Reay, Golden-Biddle, et al., 2006; Reay et al., 2016).

At the level of practice, multiple accountability implies that mHealth planners and practitioners need to engage with the paradox inherent in this phenomenon: heath intermediaries are often committed

beyond the work for which they are financially compensated. They are often not integrated formally into health systems and so work under conditions of precarious employment (Perry & Crigler, 2014; Schneider & Lehmann, 2016).

Additionally, the field of mHealth subscribes to a logic of empowerment through technology, as described in a study of openness in ICTD (Bentley et al., 2019). Health intermediaries clearly show more interest in empowerment through human connection (Kalofonos, 2014), recognition in the community (Grossman-Kahn et al., 2017) and expanding their own capabilities (Kane et al., 2016; Schneider & Lehmann, 2016), even though they still require practical and financial support for this effort to be sustainable. These findings alert policy-makers to the need to balance the instrumental logics of financial sustainability against the lived realities of health intermediaries.

6.1.3 Covert Routines

Covert routines (see 5.3.6.4) is the term used to describe routines that do not comply with the officially sanctioned processes for MomConnect registration as shown in Table 17. As a result, they were not made visible to supervising staff members. Covert routines are defined as a coordination mechanism where junior staff in customer-facing positions in hierarchical and bureaucratic organisations strive to complete their work in ways that deviate from the formal work process. They are distinct from the conventional definition of routines because they are not officially recognised and might meet with organisational disapproval, and fall outside of the scope of formal work obligations.

As described in Chapter 5, the covert routines observed at clinics included taking registration information home and performing registrations out of hours, or fitting registrations in within working hours between other existing obligations over an extended period of time. Covert routines emerged as different ways of handling those demands of MomConnect registration that could not be accommodated in clinic routine. One category of covert routine consisted of drawing on personal resources to accomplish MomConnect registration e.g. performing registrations out of hours, at home and sometimes with assistance from other members of the household. Another category of covert routine was not detailed explicitly but emerged from questions that were posed but not answered directly. This category may be described as ‘registration as coping’ – where every registration was not necessarily completed successfully but where it was balanced against the imperative to address the range of necessary tasks adequately rather than perfectly. Both clinic managers and support staff implied that MomConnect registration was not the highest priority for

the clinic, and that registration could suffer at times when personal attention to the expressed needs of clients was prioritised.

According to the coordination studies perspective, these covert routines would be made visible within the organisation. They are not, and health intermediaries continue to be required to fulfil their delegated roles and remain accountable within the clinic setting.

The IS literature contains an established concept: “workarounds”, which was not raised in Chapter 3. However, it is discussed here because of its relevance to the novel findings of the research. The same concept also appears in the HIT literature, where it is defined as the use of IS in ways that are partial (Barrett & Stephens, 2016), or intentionally diverge from the routines intended by designers (Azad & King, 2008). There are clear similarities to the concept of covert routines – but not identity with it.

Though they may appear similar, covert routines differ significantly from “workarounds”. They consist of novel ways of coordinating MomConnect registrations with existing clinic coordination mechanisms. The health intermediaries are not attempting to perform MomConnect registrations in partial ways (Barrett & Stephens, 2016) – little scope exists for that, given the simplicity and rigidity of the process. Rather, covert routines are employed for coordinating MomConnect registration with other activities in the clinic. Yet they are not officially recognised because they fall outside officially approved parameters such as routinely completing work activities within office hours or completing all officially required activities.

The coordination studies perspective suggests that routines can accomplish all three of the integrative conditions of accountability, predictability and common understanding (Okhuysen & Bechky, 2009). Covert routines are characterised by being “invisible” to the formal organisation (Star & Strauss, 1999) while informally being understood as essential to effectively accomplish all the demands placed on clinic staff. Thus although they are not officially sanctioned, covert routines contribute towards the integrative condition of predictability.

The concept of covert routines is transferable to similar, resource-constrained mHealth implementation settings, in particular where staff use mHealth to complete simple activities such as the registration of information about pregnant women (Mukherjee, 2015). It may also assist in the detailed analysis of more complex mHealth systems, such as those intended for disease surveillance (Huang et al., 2017), or transferring technical information that requires additional back-and-forth communication outside mHealth itself (e.g. remote analysis of Rapid Diagnostic Tests).

6.1.4 Towards a Substantive Theory of the Coordination of mHealth in the Workplace

This section interprets these concepts in the light of existing knowledge (Sarker et al., 2018), "generating novel theoretical insights that reframe empirical findings in contrast to existing theories" (Timmermans & Tavory, 2012, p. 174). The empirical findings and novel concepts are also used to propose directions for future mHealth research that could further develop a substantive theory of mHealth coordination in the workplace. This complemented by a more general comparison with the additional insights that other theoretical frameworks might be used to generate in **Error! Reference source not found.**.

The analysis of the cases in 5.3 identified three novel concepts describing the phenomenon of coordination of MomConnect registration, based on abductive analysis (Tavory & Timmermans, 2009; Timmermans & Tavory, 2012). These three concepts consist of two mechanisms of coordination that have not been identified previously, namely flexible roles (see 6.1.1) and covert routines (see 6.1.3), and a problematisation (Gkeredakis & Constantinides, 2019) of the coordination studies perspective through multiple accountability (see 6.1.2).

The novel mechanism of *Role flexibility* contributes to coordination by enhancing *Predictability* in the clinic; minimising possible disruption that might occur if clients were unclear on where to go in the clinic to receive the attention they need. *Covert routines* enhance *Accountability* by avoiding the disruption of exposing tasks that cannot be fully accommodated within the constraints of the workplace. The problematising condition of *Multiple Accountability* challenges coordination studies, as it stands in opposition to the accepted condition of accountability as primarily aligned to the formal organisation (Okhuysen & Bechky, 2009).

The novel mechanisms identified relate to existing areas of research within or neighbouring mHealth, and suggest that these may be fruitful areas for future research in order to help develop a substantive theory of the coordination of mHealth with existing workplace arrangements, taken in a cultural-historical setting. The findings that address the research questions further clarify what directions could help further develop theory.

These relationships between the novel concepts, research questions and related areas of research are located in relation the elements of the coordination studies perspective in schematic form, in Figure 17 below. First of all, the dominant coordination mechanisms identified in response to research question one consisted of social coordination mechanisms, primarily established roles and routines. Social coordination is also the area where the novel concepts of flexible roles and covert routines fall, suggesting that there is still much that is not yet understood. Further exploration of

social coordination and constituent mechanisms in mHealth would thus help develop substantive theory from empirical findings.

In responding to research question two, the cultural-historical setting was found to influence mHealth through artefact-based coordination. This represents a further opportunity to advance the theorisation of mHealth.

Finally, the cross-cutting problematising condition of multiple accountability indicates that health care staff and their contributions to the coordination need to be understood in terms of their various roles and relationships. In particular, the relationship of health intermediaries to the communities they serve requires further research, drawing on the broader literature on health intermediaries in resource-constrained settings.

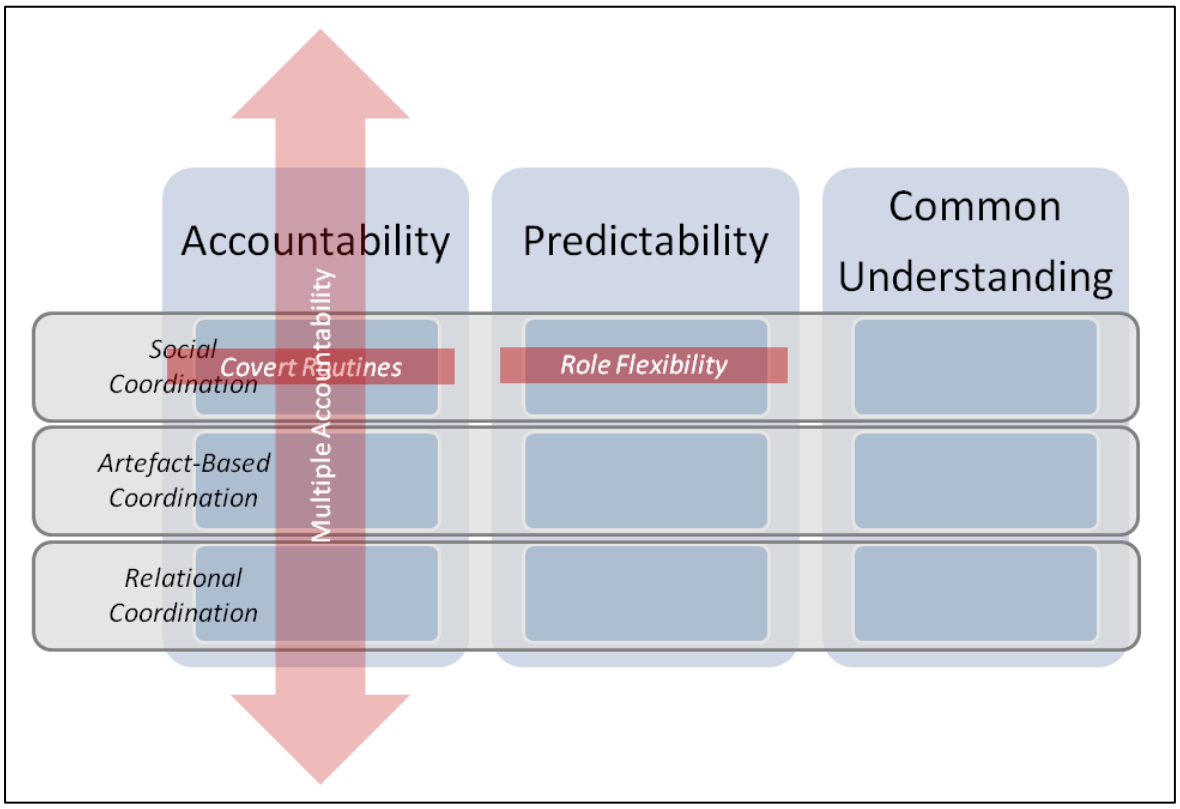


Figure 17 Locating the Theoretical Contribution relative to the Coordination Studies Perspective (based on Figure 1)

These empirically-based findings, novel concepts and related fields of research hold a number of substantive implications for research on mHealth coordination, as well as the coordination studies perspective more broadly. These are elaborated by inference from the specific conditions under which they were observed to more general settings, by comparison with evidence from existing

literature. In this way this research "generate(s) new concepts and novel insights ... and move(s) from description to abstraction" (Sarker et al., 2018).

The discovery of the mechanism of role flexibility suggests that other professionalised (possibly bureaucratic) organisations may exhibit undocumented and largely unstated temporary switches from formal roles, occurring on a regular basis, in order to support the interests of the dominant profession.

The mechanism of covert routines suggests that frontline staff in professional or other highly structured (possibly bureaucratic) organisations may complete work outside of office hours and away from the workplace. This is unexpected as the health intermediaries are not knowledge workers or managers, where research has associated this kind behaviour with these occupations in relation to mobile devices (Mazmanian et al., 2013). Stephens (2018) has recently explored how “blue-collar” staff are willing to use their personal mobile devices to support their obligations in the workplace.

Research has not uncovered direct parallels to covert routine as they were identified here. The related literature on “workarounds” (Azad & King, 2012) and coordination (Stisen et al., 2016) in similar settings has not yet extended to mobile devices.

The problematisation of the integrating condition of accountability suggests that even professional (possibly bureaucratic) organisations may be strongly influenced by staff having a sense of accountability not only to the formal organisation but to another stakeholder or cause, potentially leading to a change in coordination. There is evidence for this from the literature on health intermediaries in general Kane et al., 2016), as well as specifically from mHealth (Hampshire et al., 2016; Mukherjee, 2015) that has been noted previously in Literature Review.

However, there is also evidence about variations of this phenomenon in literature not discussed in Chapter 3. First, well-established, stable bureaucracies have been noted in which front-line staff experience a sense of multiple accountability and have to create coping mechanisms to manage this e.g. social workers who interpret official policies and informally manage clients to make their workloads bearable (Lipsky, 2010).

Second, some organisations – such as social enterprises – are founded with the aim of being accountable not only for commercial success, but in response to other goals (Battilana & Lee, 2014). Staff are thus expected to coordinate their work with an implicit sense of multiple accountability. These organisations may be relatively stable (Smith & Besharov, 2019), although research has identified that where different occupations are involved, difficulties in coordination may lead to a

shift away from multiple to more focussed accountability with staff resigning specifically because of such a shift (Battilana & Dorado, 2010).

A body of literature exists on the creation of new roles (Reay, Golden-Biddle, et al., 2006; Reay et al., 2016) or the management of multiple roles (Byrkjeflot & Jespersen, 2014; Ferlie et al., 2005), where staff are not in alignment with a single, dominant, workplace accountability. Some of this research is situated in the health care domain (Millar, 2012). Much of this scholarship does not relate to technology. However, one prominent exception is an account of the introduction of a mobile device to support the creation of a new role in the UK National Health Service, where the legitimacy of the new role was contested and the mobile device was not successful (Wiredu & Sørensen, 2006).

The relationships between the novel concepts and research questions are located in relation the elements of the coordination studies perspective in schematic form, in Figure 18 below. First of all, the dominant coordination mechanisms identified in response to research question one consisted of social coordination mechanisms, primarily established roles and routines. Social coordination is also the area where the novel concepts of flexible roles and covert routines fall, suggesting that there is still much that is not yet understood. Further exploration of social coordination and constituent mechanisms in mHealth would thus help develop substantive theory from empirical findings.

In responding to research question two, the cultural-historical setting was found to influence mHealth through artefact-based coordination. This represents a further opportunity to advance the theorisation of mHealth.

Finally, the cross-cutting problematising condition of multiple accountability indicates that health care staff and their contributions to the coordination need to be understood in terms of their various roles and relationships. In particular, the relationship of health intermediaries to the communities they serve requires further research, drawing on the broader literature on health intermediaries in resource-constrained settings.

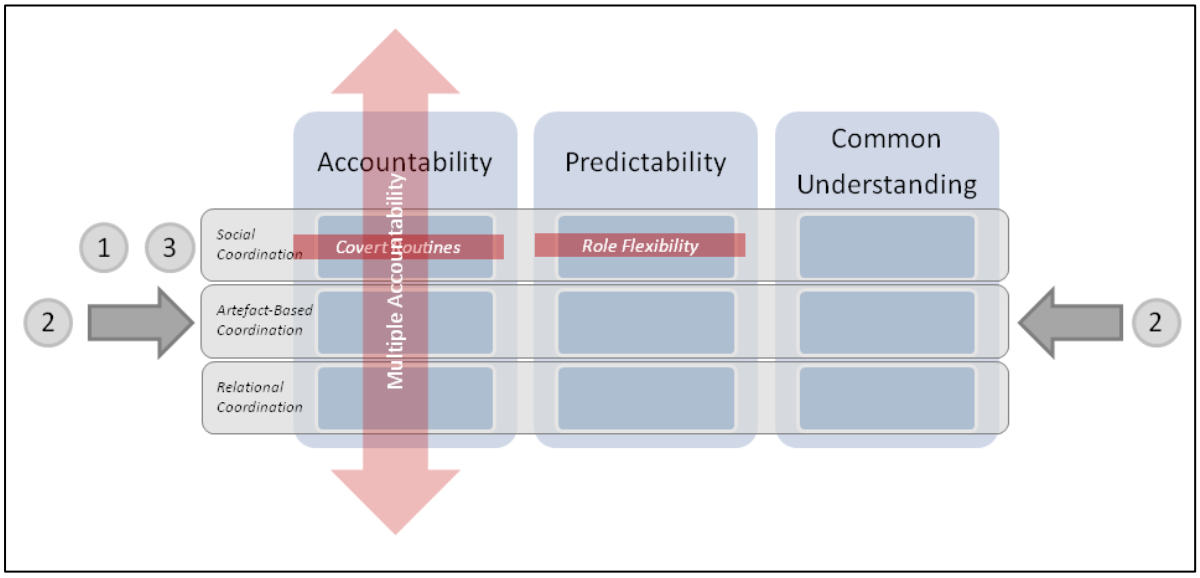


Figure 18 Positioning the Empirical and Theoretical Contributions: Towards a Substantive Theory of mHealth in the Workplace (based on Figure 17 and researcher's analysis)

6.2 Implications for mHealth

This section discusses the implications of the findings of this research for mHealth in more detail, and elaborates on the links to other areas of research.

6.2.1 Implications of Different Coordination Mechanisms

This research has described how insights from health coordination as well as HIT can usefully inform research on mHealth in the workplace by situating it in this broader literature. The plans, roles and routines identified in the health workplace generally were found to have played a decisive role in coordination in the clinics, so that MomConnect registration was delegated to health intermediaries and seldom undertaken by nurses themselves. Social coordination was thus a dominant influence as suggested by both health coordination and HIT literatures, and indeed by recent mobile communication research (Stephens, 2018), in line with the routines suggested in the training material (Table 17).

Artefact-based coordination played a more limited role, probably due to the fact that PHC clinics have fewer professional groups and specialised devices than, for example, hospitals. As described above, the three coordinating artefacts identified in the training material are the client file, the pregnancy wheel (for estimating the EDD) and the mobile phone. The field work confirmed these as the artefacts used in the registration process.

However these artefacts were not simply conduits for information as suggested in the training material. For example, it was identified that some client files were opened at multiple clinics. Clients "shopped" from one clinic to another, trying to escape grim diagnoses (Stadler et al., 2015) such as being HIV+ or having multi-drug resistant tuberculosis (MDR TB). Using a personal mobile phone to conduct MomConnect registration was not seen as problematic by many clinic staff, but there was resentment from health intermediaries who struggled with damaged screens and flat batteries on the only phones they could afford. This reflects the cultural-historical setting of inner-city Johannesburg and South Africa more broadly.

Relational coordination played a very limited role in MomConnect registration. Health intermediaries were delegated to perform the registration process but this was seen as simply another routine task, and explicit relational coordination was not identified either from interviews or observations. This concurs with the strong status differential between professional staff such as nurses and support staff (e.g. health intermediaries, hospital porters) identified in literature on the healthcare workplace (Bossen & Foss, 2016). Relationships and their management were important for both nurses and health intermediaries in the broader clinic setting in their interactions with clients.

MomConnect registration is a case where mHealth in the workplace is characterised by coordination with existing routines, in contrast to the dominant focus on the transformative potential of the technology. The clearly defined and limited scope of MomConnect registration made it possible to coordinate smoothly with existing routines in different ways and also made it easy for different registration routines to emerge at the different clinics and to subsequently shift over time. This form of mHealth – where it is largely subsumed into existing coordination – lies at the opposite end of a spectrum from those forms where the introduction of mHealth leads to the development of new routines (Chib et al., 2008; Kumar et al., 2015) or substantially modifies existing ones (Ling et al., 2018).

The development of new routines or the transformation of existing ones has been the focus of much mHealth (Labrique et al., 2013) and Mobile Communication (Campbell, 2019) literature, in line with a view that these technologies are fundamentally benign (Bentley et al., 2019).

This research has demonstrated that new channels of communication between the people connected via this service (managers, nurses and pregnant women) are indeed beginning to become active. Managers at national and district levels have been offered greater visibility into work at the clinic level through the availability of regular monthly reports of MomConnect registrations. They

have been enabled to compare registrations not only over time at each clinic, but also between registration rates at different clinics. Management feedback to the clinics at the time of the study was limited, but the clinic managers made it clear that they were required to respond to the specific complaints that had been forwarded to the regional offices. This holds the potential to challenge the current level of authority of clinic nurses.

MomConnect enabled pregnant women to report their perceptions of the service they received at the clinic. The MomConnect project at national level reported that over 90% of such comments were classified as compliments rather than complaints, but on several occasions the nurses at the clinic informally indicated substantial anxiety that the mothers might complain about the service they received. This suggests that communication that potentially challenges existing power relationships is perceived as far more threatening than increased visibility to management, which latter is in alignment with existing power relationships.

Limited extant mHealth research currently examines the specific processes behind the establishment of new lines or modes of communication and how these might become institutionalised (Ling et al., 2018), or the possible implications for existing health care systems (Asangansi, 2016). This research adds to this stream, and suggests that the coordination studies perspective is a powerful lens through which to examine cases where continuity with existing health care routines is intended. Since successful implementation relies on widespread integration into existing coordination processes, this is a significant finding.

Outside and in contrast to mHealth research, and not explored previously in the Literature Review (Chapter 3), a well-established literature exists on HIT as large-scale sociotechnical systems (Braa, Hanseth, Heywood, Mohammed, & Shaw, 2007; Sahay, Monteiro, & Aanestad, 2009; Sahay et al., 2019). Research explicitly linking mHealth to this is relatively limited (Asangansi & Braa, 2010). Nevertheless the concerns of health infrastructure research such as scalability (Sahay & Walsham, 2006), standardisation (Braa et al., 2007) and the politics of integrating with existing HIT (Sahay et al., 2009) are highly relevant to mHealth. Many of these studies have been carried out in developing country settings, making them particularly relevant.

The discipline of mHealth has benefitted from the attention of mobile communication and health care researchers. This research has incorporated insights from IS and health care organisations in a more systematic way, in order to advance the body of knowledge concerning mHealth more rapidly.

6.2.2 Implications of Health Care Organisation

The implications of the introduction of new technology in workplaces, especially among knowledge workers, has been extensively explored (Barley, 1986; Leonardi, 2011; Orlikowski, Yates, Okamura, & Fujimoto, 1995; Sørensen et al., 2008). Most of these studies were of cases where use was mandatory, but even some of the most restrictive cases have yielded examples of active coordination with existing work practices (Boudreau & Robey, 2005) rather than simple compliance to management directions. This is particularly relevant in the case of HIT (Romanow et al., 2012). This research has provided compelling evidence that the same phenomenon also occurs in mHealth.

This research has identified that coordination closely followed the officially recommended routines in two of the three clinics studied when field work commenced in 2015, but when the clinics were revisited in 2016, the picture was more complex. As noted in Chapter Five, in one clinic, the officially recommended routine was still being followed, but there was concern from the manager as well as the health intermediary conducting the registration that this was not sustainable because of the allocation of the health intermediary to duties outside the clinic and the lack of other staff to fill this gap.

In the other clinic where the recommended routine had been followed in 2015 the task of registration had been delegated to a newly-formed team of health intermediaries in 2016. This team had dissolved by the end of the field study because of cessation of funding. The health intermediary who had previously performed registrations was often unavailable to return to this work because of new additional responsibilities.

Health care is characterised by well-established coordination mechanisms, which have been extensively documented (Bossen & Foss, 2016; Ellingsen & Monteiro, 2003; Fitzpatrick & Ellingsen, 2013; Stisen & Verdezoto, 2017). The strongly defined roles integral to health care coordination have been identified as a reason for resistance to HIT by health professionals (Kane & Labianca, 2011).

Health care coordination is not merely a locus of resistance, however. Research (A. K. Barrett & Stephens, 2016; Goh et al., 2011) has suggested that this resistance may be resolved by implementation approaches that build on established informal networks. This concurs with evidence of the strength of established coordination mechanisms identified in mHealth research (Chib et al., 2008; Mukherjee, 2015). Informal networks have been shown to be important in HIT (Barrett & Stephens, 2016) and may also be important to promoting mHealth coordination, particularly in cases that necessitate shifts in the relationships between different occupations.

The ability of nurses to delegate MomConnect registration to support staff is a result of their position of workplace power. However it also results in ambiguous responses to MomConnect; such ambiguity enabled them to support the idea while rejecting direct involvement in registration as "unprofessional". Other studies have also identified concern about the disruption of existing routines plus recognition of benefits to patients as leading to ambiguity (Sharma & Clarke, 2014; van Offenbeek, Boonstra, & Seo, 2013). Recent research on ambiguity in IS coordination has drawn on cases from the health sector (Kane & Labianca, 2011; van Offenbeek et al., 2013). This research foregrounds the particular relevance of such cases to mHealth.

One of the clearest themes emerging from the interviews and observations during this research was the strong sense of professional identity felt by the nursing staff. This professional identity was associated with a clear sense of appropriate scope of work and division of labour: a hallmark of professional identity. This theme has been noted before in the HIT literature (e.g. Kane & Labianca, 2011; Romanow et al., 2012). While this displacement (or avoidance of using HIT as designed) has been identified as "resistance" to implementation (Romanow et al., 2012), there have been only isolated attempts to understand the specific details of how this influences ongoing coordination of work practices (Wears & Berg, 2005).

Recent research in a health care context has suggested that attitudes to, and actual coordination, may vary independently (van Offenbeek et al., 2013). That study examined a setting where nurses worked together without any support staff involved, and where the nurses' use of the system was accepted as part of their professional duty. The present research suggests that the acceptance of HIT or mHealth as part of the scope of professional work is important to understanding the likelihood that delegation to more junior staff may take place.

6.2.3 Implications for the Study of Health Intermediaries in Developing Countries

The professional role and status of nurses established them as the authorities in the clinics, and made them the key gatekeepers whom the MomConnect training addressed. This confirmation of their position of power enabled them to shift the work to health intermediaries without any sense of being threatened. Indeed, the sentiment that "it's not professional work" reflects the reactions found in other studies of doctors shifting HIT use to nurses (Kane & Labianca, 2011).

In contrast, the introduction of an mHealth application to register pregnant women and young children in India was linked to the remuneration of the itinerant Assistant Nurse Midwives (ANM). The relationship of the ANM to the clinic doctor was reported by one informant as shifting: largely

displacing the previous practice where the doctor was consulted for advice on difficult cases with one of discussing the numbers of registrations (Mukherjee, 2015).

Health systems in developing countries emphasise PHC as an important way to provide services to the general population and especially those who do not have ready access to hospitals because of their remote location. mHealth has been promoted as a way of leveraging the effectiveness of PHC staff such as nurses and health intermediaries. Health intermediaries are not necessarily well integrated into PHC clinics and the health system more broadly in terms of having stable employment or clear career pathways (Clarke et al., 2008; Grossman-Kahn et al., 2017; Maes & Kalofonos, 2013). This concurs with what was also identified in this research and poses risks for sustaining large-scale mHealth.

Research on health intermediaries has suggested that non-financial motivation also matters to many of these staff (Kalofonos, 2014). This is reflected in how health care staff voluntarily use their own money to provide "informal" mHealth (Hampshire et al., 2016; Ling et al., 2018). However, planning mHealth on the basis of this commitment is not only impractical but also ethically questionable. To the best of this researcher's knowledge, it has not been formally attempted. Nevertheless, this situation underlines the tension between mHealth as a planned intervention and the lived experience of health care staff in resource-poor settings.

Health policy and planning tends to avoid discussing this tension. Yet within it exists the potential for a complementary approach to health care delivery and mHealth emphasising the importance of affirming the role and voices of the responsible staff. Such an approach has proved important in improving health care in resource-constrained settings elsewhere (Maes & Kalofonos, 2013), even though may not be easily compatible with top-down bureaucratic processes or donor requirements for meeting clear project milestones. Neither does it easily integrate with the techno-optimistic solutions and grand plans that have hitherto dominated conversations on the possibilities offered by mHealth (Chib, 2013; Labrique et al., 2013). This research is a contribution to an emerging literature that is moving away from the techno-optimistic mainstream (Bentley et al., 2019) and identifying the kind of issues faced by PHC staff in mHealth in a resource-poor environment (Anstey Watkins et al., 2018; Hampshire et al., 2016; Ling et al., 2018; Mukherjee, 2015), thus challenging approaches that do not recognise these realities.

The coordination of MomConnect occupies a position between the in-hours routine suggested by the official training material and the "informal mHealth" described by Hampshire et al. (2016) where health workers donate their own time and use personal handsets to support clients. Although the

phenomenon of “informal mHealth” has not received much attention from subsequent researchers, there is evidence that it occurs relatively frequently: a number of subsequent studies do note staff members making use of mobile technology at their own cost (Anstey Watkins et al., 2018; Ling et al., 2018). This suggests a blurring of the boundary between official work obligations and personal time (Mazmanian et al., 2013) that is, by definition, unsustainable.

Heath intermediaries outside the mHealth setting in the developing world have been reported as facing similar situations of no or minimal pay (Maes et al., 2019; Maes & Kalofonos, 2013; The Hindu. Karnataka Bureau, 2018) even for extra duties. While financial compensation matters for such workers (who need to support themselves and their families) their identities as caring people (Kalofonos, 2014) with a sense of connectedness to the communities they serve (Kane et al., 2016), are also important.

This was reflected in the research conversations with clinic health intermediaries. In two of the clinics support staff volunteered their desire to work more outside the clinic, doing outreach to surrounding communities. When this issue was explored in subsequent interviews, several additional staff confirmed a similar interest. This could be ascribed to a desire to move out of the direct control of the registered nurses in the clinic. However, it is also in line with the declared intentions of South Africa’s NHI to establish large-scale community outreach teams.

MomConnect was implemented with the aim of improving maternal health via information text messaging. The involvement required by nursing staff is low, and the benefits of providing information to pregnant women have never been disputed. Nevertheless, clinic staff sometimes displayed ambivalent attitudes towards MomConnect. This may be understood as a response to an intervention that offered the staff no direct benefit, and indeed made it possible for clients to report unsatisfactory service, threatening the position of power enjoyed by the nurses in relation to clients (Jewkes et al., 1998). However, there was little evidence that MomConnect had resulted in management sanctions of any sort, and the overwhelming proportion of feedback by pregnant women on clinic service was positive.

6.3 **Contributions and Limitations**

This research has compelling argued that mHealth in the workplace can be fruitfully analysed in terms of coordination with existing activities. In addition this approach also accounts for the influence of the broader cultural-historical setting, particularly through the impacts this has on artefact-based coordination. To achieve this, it has synthesised the literature on coordination in the health workplace, HIT and mHealth. The perspective developed on these foundations enables

researchers to uncover how mHealth in the workplace is integrated with existing coordination mechanisms, as well as how it may also give rise to new forms of coordination.

The contributions to empirical understanding, to theory, and to practice that this perspective yields are set out below.

6.3.1 Contribution to Empirical Understanding

Theoretically-grounded interpretive accounts of mHealth coordination have only recently started to emerge (Ling et al., 2018; Stephens, 2018) and prior research has been primarily descriptive and emphasised single occupations such as doctors (Kane & Labianca, 2011) or in less-developed countries, health intermediaries (Chib et al., 2008). Where more than one level of staff has been examined these have overwhelmingly been doctors and nurses, while health intermediaries and support staff have been neglected. This research thus makes an original contribution to knowledge through an analysis of mHealth as coordination among PHC staff (nurses and health intermediaries) and by revealing how this is situated in an organisational and cultural-historical setting.

Specifically, this research has clearly shown that social coordination (in particular, through roles) plays a decisive role in determining the form that mHealth coordination takes, as identified in Chapter 6. Nurses delegated MomConnect registration to health intermediaries in all of the clinics, although in Clinic C registrations were briefly performed by the WBOT leader (a nurse) (see Figure 12, Figure 13 and Figure 14). This is in line with what has been found in the literature to date, including the broader HIT literature. The ANC nurse was present at registrations in Clinic B, but did not perform them herself.

A further contribution is a more nuanced understanding of the way health intermediaries are involved in mHealth routines. While the health intermediaries carried out most of the MomConnect registrations, the individuals changed over time in most cases. Only the health intermediary in Clinic A performed MomConnect registrations over almost the entire period during which fieldwork visits were carried out. At Clinic B the ANC nurse stated that the volunteers were unwilling to assist, and in line with this was busy training health intermediaries and other staff who were not volunteers at the end of the fieldwork period. At Clinic C the health intermediary who performed registrations in 2015 delegated responsibility for this to WBOT members. The WBOT members were not enthusiastic about performing registrations, and near the end of the fieldwork the WBOT leader, a nurse, had taken on this responsibility. Shortly after this the WBOT dissolved.

This research thus provides decisive evidence that mHealth routines change over time, as health intermediaries accept, delegate and sometimes avoid involvement. This contrasts with extant

mHealth literature that shows health intermediaries as passive in accepting their responsibilities. In the case of ANMs in India (Mukherjee, 2015), financial rewards were tied to the number of registrations which could explain their compliance with the expectations placed on them.

This research has also clearly shown that health intermediaries responsible for mHealth act out of a sense of accountability not only to the clinic but also to the wider community. This is in line with the literature on informal mHealth, as well as the literature on health intermediaries more broadly. This research has moved beyond empirical description of this phenomenon to extending theory to account for this (see 6.3.2).

Another contribution to empirical understanding from this research is the compelling evidence of routines that emerge where health intermediaries either go above and beyond their formal obligations in implementing mHealth, or manage this responsibility as best they can with the implicit understanding from the clinic management that trade-offs need to be made. This is an issue that has been neglected in the mHealth literature, or at most described in terms of a need for additional training.

The understanding of existing health care institutions (such as clinics) as sites where routines and priorities are already established, and where mHealth is accepted as one among many responsibilities, has yet to be taken into account in the literature. Improved understanding of this issue is critical to understanding the prospects for wide-spread and sustainable implementation of mHealth in existing health systems.

Finally, this research has compellingly shown that mHealth in the workplace is influenced by issues from the cultural-historical setting in which it is implemented. In the case of MomConnect, these are primarily from artefact-based coordination. Restrictions on mHealth effectiveness due to limited network connectivity are well established in the literature. This research has revealed that there are also concerns among health care staff, and particularly health intermediaries, around using their own handsets to implement mHealth because of the poor condition of their cell phones due to precarious financial positions.

Further, seemingly neutral artefacts such as the patient file and passports pose challenges for mHealth because of the conditions of the South Africa inner city setting. Chronic and debilitating diseases such as TB and HIV/AIDS are prevalent, and diagnoses for these conditions are captured in the patient file. In poverty-stricken inner-city neighbourhoods diagnoses for these conditions sometimes prompt “shopping” between clinics and result in duplicate files being opened, with consequent challenges for effective information management. This behaviour is counter-productive

in terms of promptly starting treatment but can be understood as an expression of an aspiration to a "better life" (Stadler et al, 2015). Undocumented immigrants seeking public health care are unable to produce valid identification documents prompting them to borrow passports or purchase fake ones. As a result MomConnect records invalid information or refuses to allow women to register at all. Neither of these issues have yet received attention in the literature, despite the obstacles that they are likely to present to mHealth implementation in other developing world settings.

6.3.2 Contribution to Theory

This research contributes to theory by extending the coordination studies perspective through the two novel constructs of role flexibility and covert routines (see 6.1.1 and 6.1.3), and by problematising the integrative principle of accountability through the concept of multiple accountability (see 6.1.2). These concepts offer a means of conceptualising the empirical phenomena identified in the field while also maintaining a systematic relationship with the integrative conditions of accountability, predictability and common understanding underpinning the coordination studies perspective (Okhuysen & Bechky, 2009).

This extended theory was developed abductively (see 4.4) for analysing how mHealth in the workplace is situated in relation to existing coordination mechanisms, as well as the new coordination mechanisms that arise under the influence of the broader cultural-historical setting. This perspective is particularly appropriate in settings where existing coordination mechanisms are well established and mHealth does not result in substantial transformation to them. Such settings would include formal health care institutions e.g. clinics and hospitals. The perspective may also be transferable to understanding client-facing work in settings outside of health care, where professional identity and associated forms of coordination are already well established, e.g. social work (Lipsky, 2010) and legal resource centres.

Role flexibility was developed as a conceptual category encompassing the ways clinic staff of different designations (excluding nurses) worked together temporarily but regularly to coordinate client folder queues. The departures from formal roles and responsibilities here were clearly institutionalised despite departing from the formal responsibilities typical of a bureaucracy (see 5.3.6.2).

The coordination studies perspective employs the construct of the role as a means of explaining what staff can expect others to contribute to achieving a particular goal. In other words, a formally defined role is expected to promote monitoring in, and a common perspective on, coordination (Okhuysen & Bechky, 2009). The concept of role flexibility was developed in a setting where

professional staff (nurses) and non-professional staff (health intermediaries) work together in the process of coordinating. The field work facilitated the development of insights on how the integrative conditions of accountability and common understanding can be met through a temporary shift in the scope of certain roles, rather than their remaining fixed. It holds potential applicability for any other settings where this occurs.

The second concept emerging from the data analysis was that of covert routines. This concept describes the routines performed by health intermediaries to achieve MomConnect registration and specifically those falling outside the parameters of the suggested routines (see Table 15) that were also not made explicit. Covert routines emerged only via informal conversations and through observation, not in interviews. While role flexibility was exhibited by both health intermediaries and support staff such as administrators, covert routines were, by contrast, typically performed only by the health intermediaries responsible for MomConnect registration. Thus the concept does not include the group registration routines performed together by nurses and intermediaries.

While not part of any officially prescribed sets of routines, covert routines have been identified as relatively common by other research on MomConnect. Routines in the coordination studies perspective can accomplish all three of the integrative conditions: accountability, predictability and common understanding (Okhuysen & Bechky, 2009). Covert routines, however, are characterised by being “invisible” to the formal organisation (Star & Strauss, 1999) while informally being understood as essential to effectively accomplish the range of demands placed on clinic staff. Covert routines thus contribute towards the integrative condition of predictability, despite not being officially sanctioned.

The concept of covert routines is transferable to similar settings of mHealth implementation in resource-constrained environments, particularly where staff use mHealth to complete simple activities such registering pregnancy information but resort to non-sanctioned activities to complete their work. Mukherjee (2015) provides the example of drawing on family members for assistance in a regular basis. The concept may also assist in the detailed analysis of more complex mHealth systems such as those intended for disease surveillance (Huang et al., 2017) or transferring technical information requiring additional back-and-forth communication outside mHealth itself, such as remote analysis of Rapid Diagnostic Tests.

The third concept emerging from the data is multiple accountability. The coordination studies perspective assumes that the division of roles and responsibilities between staff members is well defined, and the theory focuses on relationships between staff members. Multiple accountability

was developed as a coding category emerging from the transcripts, supplemented by insights from informal conversations and observations. It was additionally informed by the wider setting of PHC re-engineering, and extant research on the experiences of health intermediaries in South Africa and other developing countries.

The official training materials present MomConnect registration routines as happening within the confines of the clinic (RMCH, 2014). Other materials on MomConnect note the system has capabilities to enable health intermediaries to register pregnant women as part of community outreach outside clinics and without a consultation with a nurse (National Department of Health: Republic of South Africa, 2014b). As described earlier, however, the messages from MomConnect were limited until a full consultation with a nurse at a clinic had occurred and all necessary information (especially the EDD) been recorded.

However conversations with health intermediaries revealed wide awareness of, and interest in, community outreach. They experienced MomConnect registration in the clinics as an additional burden to existing routine coordination, but many were not aware of MomConnect's option for registration outside clinics. Many, however, expressed a sense of solidarity with the community referred to earlier: an obligation not only to in-clinic colleagues and clients but also to clients as people in the community accessible through outreach work (see for example 5.3.2.4).

The coordination studies perspective uses the concept of accountability to describe a quality of relationships within the organisation. Multiple accountability as it emerged in this research breaches this framework. It describes how organisational members experience coordination as something requiring orientation beyond the clinic and towards the broader community, at a time when the official structures to enable this are still only in the process of being implemented.

Multiple accountability has emerged from a number of mHealth studies describing how staff relate to clients in ways outside of officially recognised terms of engagement, as in the use of personal mobile phones described by Hampshire (2016) and discussed above. Intermediaries' sense of accountability to clients additional to their formal clinic obligations led them to implement "informal" mHealth.

In all the ways described above, this research makes its theoretical contribution by extending the coordination studies perspective on mHealth in the context of developing-country PHC clinics. This extended analytical framework offers transferability to other developing country settings that are characterised by health intermediaries working with health professionals in the coordination of

mHealth. It may also be transferable to developed world settings characterised by less formal care giving e.g. (Martinez, Ro, Villa, Powell, & Knickman, 2011).

6.3.3 Contribution to Practice

This research contributes a number of insights of importance to practitioners. The practitioner community has assembled several development methodologies to take into account the needs of both staff and community users (see, for example Chhoun et al. (2019)). The current research has demonstrated that even where mHealth is designed to fit in with existing coordination practices and also with regard to local conditions (e.g. the lack of availability of widespread internet connectivity); there are still departures from carefully developed guidelines. As a result practitioners need to be monitor mHealth coordination in the workplace to ensure that the technology operates effectively, but also that existing roles and routines are not disrupted despite careful planning.

In particular, this research highlights the burden is placed on health intermediaries by mHealth implementation. Practitioners need to be mindful of the vulnerable position that health intermediaries occupy, and not simply draw on their commitment to assisting the community for the benefit of the implementation. This poses a challenge to practitioners that has not yet been directly confronted, but is of great significance not only for successful implementation but also for honestly engaging with the marginalised nature of many health intermediaries.

Another important contribution is the clear demonstration that artefact-based coordination is a powerful methodology for identifying the particular ways in which the cultural-historical setting influences mHealth in the workplace. For example, that neutral-seeming artefacts such as patient files and identification documents can be unreliable not simply because of poor information management, but also because of issues specific to the setting such as undocumented immigration and chronic disease leading to “irrational” coping strategies.

6.3.4 Research Limitations

Categories of health population studied. This case study research focused on three inner-city clinics to explore mHealth coordination by staff under the testing circumstances of public health care for relatively impoverished populations. It did not address coordination in the private health care sector. Anecdotal evidence suggests that wealthier women may have more access to other sources of information through more convenient consultations with both private providers and the internet. MomConnect registration may thus be less important for their health and wellbeing, and easier for better-resourced private facilities to support.

Additional role-players. The focus of the study was also limited to MomConnect registration by staff, for ethical and practical reasons. Client experiences of MomConnect were addressed in a limited way, and a study that addressed this issue too could reveal a more detailed picture of the influences on and limitations of MomConnect. Anecdotal accounts of MomConnect registration at hospitals suggested that registration was done by the ANC nurses, possibly because support staff were not as readily available. A comparison of coordination at clinics versus hospitals would provide useful additional insights.

Familiarity with setting and language context. Obtaining interviews with public clinic staff required repeated visits to clinics in order to finally meet with them. This researcher was not familiar in detail with the clinic environment or fluent in the languages generally used by staff to communicate with each other. Research where the particular health care setting is better known and where the language of the informants is familiar have the potential to reveal more insights.

Sensitive information. The health intermediaries' experience of their place in the clinic emerged as an important theme in the analysis of both informal routines and responses to the time pressures on MomConnect registration. This was largely inferred from informal conversations in this research which would ideally have been conducted in their home languages (which were not English). However this would have required a mastery of the home languages used by the informants and insider status in the clinic, both of which were absent in this research.

Uncertainties associated with abductive reasoning. Abductive analysis is based on creative reasoning from cases in order to develop theoretical insight (Atkinson, 2018). Three methodological steps are recommended to ensure that this is a rigorous process: revisiting the phenomenon, defamiliarisation and alternative casing (Timmermans & Tavory, 2012). All three of these steps were followed in the analysis presented in this thesis. However the process of alternative casing (assessing other possible explanations through existing theory) was particularly challenging in this research as the phenomena foregrounded in this research have received little systematic attention to date.

Three alternate theoretical framings (using Structuration Theory, ANT and Activity Theory) were attempted and rejected after fatal shortcomings were identified in each. The novel constructs identified from this research have thus been confirmed as a compelling extension to the coordination studies perspective. While the three alternative theoretical casing attempted are based on major theories in IS this also constitutes a limitation as further theories might also have been examined.

Chapter Seven below concludes this thesis with reflections on the implications of these findings for setting, future research, and associated disciplines such as pervasive computing.

Chapter 7 **Reflections and Conclusions**

7.1 **Introduction**

This research has explored how mHealth coordination by staff in existing PHC clinics occurs, through a case study of clinics that form part of a national initiative: MomConnect. A central assumption of extant mHealth literature is that the technology empowers health care staff and leads to increased efficiency in service delivery. This assumption foregrounds the transformative potential of mHealth and the active appropriation of the technology, but obscures how it integrates with existing workplace arrangements.

Much extant literature on mHealth emphasises the requirements for, and effectiveness of, stand-alone projects (Chib et al., 2015; Labrique et al., 2013; Lee et al., 2016; Nurmatov et al., 2014). It often adopts an implicitly top-down focus on the needs of funders and managers. Such studies are important contributions as the field moves towards increasing maturity. However, this research has taken a different approach and chosen to examine the mHealth in the workplace at clinic level, as the staff coordinate MomConnect registration with their daily routines. This was driven by the researcher's stance that the local priorities and practices of front-line PHC staff are significant in their own right, and provide a necessary complementary perspective to that of health managers.

But mHealth literature was not the only scholarship considered. Unsurprisingly, given the relative youth of the mHealth field, HIT literature has addressed the challenges around scaling (Braa et al., 2007; Sahay & Walsham, 2006) and sustainability (Kimaro & Nhampossa, 2005) in more depth than has been achieved to date in mHealth. For this reason, HIT scholarship supplemented the mHealth literature in informing this research. A perspective on coordination based on the work of Okhuysen and Bechky (2009) was used to structure the Case Analysis.

This chapter reflects on the research process and on its implications for the relationship between mHealth and existing health systems in developing countries. It goes on to discuss the relationship between development priorities and mHealth. After proposing and exploring the most fruitful avenues for future research, the chapter concludes by considering recent developments of practical importance for mHealth, foregrounding discussion of the socio-economic imperatives for enhancing understanding (and implementation) of coordination in mHealth.

7.2 **Theoretical Framing, Relevance and Ethics**

The study of the coordination of MomConnect by clinic staff was based on a commitment to exploring the process of as experienced by staff of different status, building on the research of

Stephens (2018) and others. This contrasts with the more widespread emphasis in IS on researching how innovations are employed by knowledge workers (Mazmanian, 2013; Sørensen et al., 2008).

A coordination studies perspective (see Figure 1) was used to frame this research in order to examine mHealth in the workplace in the context of existing work practices. Much coordination research emphasises the mechanisms used to ensure the successful achievement of organisational objectives, with more limited attention given to relationships in the workplace. The literature on relational coordination was used to guide the researcher's exploration of the issues around relationships emerging from the field work: relationships with colleagues as well as clients emerged as key in situating MomConnect coordination.

There is general consensus that health intermediaries are important in achieving progress towards UHC, with mHealth widely seen as an important enabler of intermediaries in this process. This research has explored the lived experiences of nurses and health intermediaries in the process of mHealth coordination. The findings suggest that the effectiveness of a strategy that draws on health intermediaries to implement mHealth should not be taken for granted. Although building the capacity of health intermediaries and improving their integration into the wider health system is important for supporting the effectiveness of mHealth, it is possibly equally important to ensure they feel they are valued and have a sense of purpose (Kalofonos, 2014). Nevertheless, it is likely that public health systems in developing countries will remain constrained in the support offered to health intermediaries for some time.

All these factors helped the researcher shape a framework for studying mHealth coordination by clinic staff. This framework in turn led him to focus on MomConnect as part of ANC practices, and on a qualitative investigation of coordination. It additionally emphasised connecting with the experiences and practices of the staff, while maintaining respect for their right to disclose (or not disclose) as they saw fit. Nevertheless, the interpretive orientation adopted led to a commitment to understanding the phenomenon "from the inside" (Charmaz, 2014).

This research sets its understanding of mHealth in the workplace in a cultural-historical setting, thus foregrounding the role of the researcher in the research process (Charmaz & Mitchell, 1996; Charmaz, 2014). The overwhelming majority of PHC clinic staff are black; additionally the intermediary staff are often young, with limited tertiary education. The identity of this researcher as an older white male who grew up under apartheid is thus not incidental to the process of field research, as discussed in more detail by Krauss (2013). This was addressed in part by combining first-

person reporting to convey the specific sense of “being there” with more conventional academic description and analysis (Charmaz & Mitchell, 1996).

7.3 mHealth and Existing Health Systems

mHealth in developing countries has often been hailed as a technology enabling rapid improvements in health care delivery. This view implies that technology can improve health outcomes (Bentley et al., 2019) without the hindrances of inefficient or dysfunctional existing health systems, and that somehow this will help developing countries leapfrog over health care challenges (Kimenyi, 2015; Rockefeller Foundation, 2010).

More cautious researchers and practitioners, however, acknowledge that mHealth is only one of the approaches that need to be implemented to achieve this broader system-wide improvement (Chib, 2013; World Health Organization and International Telecommunication Union, 2012).

Little attention has so far been given to the institutional aspects of how improved health service delivery can scale up from successful project implementation to strengthened health systems. Large-scale mHealth initiatives that integrate with existing health systems are still relatively rare in developing countries. Viewing mHealth as simply a route to increased efficiency encourages initiatives that add to the responsibilities of frontline health workers, without considering their needs or preferences.

This research has identified that mHealth implementation has involved task-shifting from nurses to health intermediaries in the clinics under study. The experiences of the health intermediaries of this additional load were coloured by issues such as limited job security and benefits. However there was also a positive disposition towards community outreach, despite the additional load that this placed on the health intermediaries. This supports other findings (not only related to mHealth) that health intermediaries are motivated by a sense of purpose (Hampshire et al., 2016; Kalofonos, 2014; Maes, 2015), as well as financial compensation.

These developments point to the utility of moving beyond studies of individual systems (whether from the perspective of managers or frontline staff) and broadening the research focus to examine how different systems work together. IS has a well-established tradition of researching information infrastructures, where different systems are interconnected and become part of mundane practices (Hanseth & Lyytinen, 2010; Monteiro, Pollock, Hanseth, & Williams, 2012). HIT has also been investigated using this approach (Aanestad & Jensen, 2011; Bygstad, Hanseth, & Le, 2015). However, it has not yet been systematically applied to mHealth.

This suggests the need for deeper engagement with stakeholders in mHealth implementation, both front-line staff and health managers, with due regard to the implications for local practices, and especially for the most vulnerable staff. Informally employed health workers have recently demonstrated that they require engagement from government on issues such as working conditions and benefits (teleSUR, 2017; The Hindu. Karnataka Bureau, 2018). Thus mHealth projects are no more immune to resistance than their equivalents in other fields, providing additional motivation for such deep engagement.

7.4 **Development Priorities, Design and Implications**

During the past decade, funding for development interventions in health care has come increasingly from private sources such as large foundations rather than from government aid. This shift, together with the emphasis of the aid industry on technical aspects, minimizing political implications (Ferguson, 2007) has contributed to mHealth projects being presented with a relatively scant grounding in their specific contexts of implementation. With a few exceptions (Chib et al., 2008; Mukherjee, 2015), even the relevant literature is relatively silent on this aspect.

Development agencies and private donors are understandably concerned with the positive impact of their interventions, rather than with in-depth analysis. However, moving from projects to large-scale implementation is likely to intensify the need for improved understanding and debate about design, implementation practices, local circumstances and the relationships between these. The data yielded by this research are an initial contribution to developing such a debate.

The mHealth field has to date adopted a vision of technocratic solutions to the complex sociotechnical challenge of health systems strengthening (Roess, Gurman, Ghoshal, & Mookherji, 2014; Vital Wave Consulting, 2009; World Health Organization, 2011). This process has obscured the existence and impact of issues that cannot be resolved by technology, and has been noted as a feature in international aid more than ten years ago (Ferguson, 2007).

There is lively current debate in the literature on health interventions in relation to health systems strengthening (Kane et al., 2016; Maes et al., 2019; Schneider et al., 2018; Schneider & Lehmann, 2016). This debate foregrounds the relative efficacy of targetted versus integrated interventions. However, research on scaling up focused maternal interventions in developing countries has concluded that it needs to be part of overall health systems strengthening (Knippenberg et al., 2005; Smith et al., 2015).

The findings of this research concur with one important implication of the research summarised above: institutionalizing mHealth will require both clear policy development and engagement with

stakeholders at all levels. Although mHealth offers the promise of rapid roll-out of new services using available infrastructure and staff to make a marked different to health outcomes, this may not be as easy to realize as some advocates suggest.

Further, experience with the issues facing HIT implementation suggests that the characteristics typical of mHealth may make it even more challenging to scale up successfully. HIT is infrastructural in the sense that it can link the different parts of a facility such as a hospital for information exchange. Mobile services, however, are infrastructural in a broader sense. Mobile networks, and more visibly mobile handsets, occupy both the private and public domains. Where HIT can generally be left behind in the workplace, mobile services and handsets are personal, available on the move and whenever they are called upon. This facilitated, for example, the instances observed in this research and cited in section 5.3.4.4 of support staff taking MomConnect client details home to perform registrations after hours. Other scholars have reported how individuals in resource-poor environments have voluntarily started using their handsets to provide a ground-up approach to mHealth (Hampshire et al., 2016). Such an effective “privatisation” of work illustrates the Janus-like nature of the mobile handset (M. Arnold, 2003).

mHealth coordination has thus been shown in this research to lead to a form of task-shifting that differs from the doctor-nurse form that remains within the bounds of the workplace (Georgeu et al., 2012; Kane & Labianca, 2011). The nature of mobile services and handsets has shifted mHealth use not only between occupations, but at times also from public to private space, and from “work time” to “leisure time”. This researcher attended one seminar hosted by a development agency where such dedication was lauded by a speaker (MEASURE Evaluation, 2016), but there is currently little evidence about whether the long-term effects will be positive or negative.

Thus, although HIT research has this informed this mHealth investigation, the differences identified above indicate that the features of mobile services carry their own, distinct implications for mHealth use.

7.5 mHealth and Ubiquitous Computing

The field of IS has long focussed on the study of phenomena where the technological artefact plays a prominent role (Akhlaghpour, Wu, Lapointe, & Pinsonneault, 2013; Orlikowski & Iacono, 2001). This is natural in a discipline that has at its core a concern with technological innovations and their social implications. Ubiquitous computing suggests a different set of concerns however, more oriented to design (Dourish, 2004a). When technology is wearable, unnoticed, and recedes into the background

of lived experience, the social implications become less and less obvious – and also less accessible to established research approaches.

MomConnect registration falls precisely on the fault line between mobile IS and ubiquitous computing. MomConnect uses technologies that are familiar to the nurse and health intermediaries from their existing experience with mobile handsets and services. It is largely influenced by – rather than an influence on – the work practices, roles and relationships of the staff. Yet this research began to bring into sharper focus the broader implications of mHealth as a persistent and intensifying activity in the clinic workplace.

MomConnect is easy to use, and (when the registration process is not interrupted by a network connection error) is a relatively minor additional burden. When conditions are conducive, it can recede into the background like any smooth-running infrastructure. Breakdowns in the registration process bring MomConnect to the fore again as it needs to be grappled with, and at those moments it becomes an activity in its own right rather than an almost reflex action. A developing stream of research on such issues (Matavire & Manda, 2014; Monteiro et al., 2012; Pipek & Wulf, 2009) could support this kind of analysis in the future, as mobile computing increasingly blurs the distinction between the personal sphere and the workplace (Mazmanian et al., 2013).

7.6 **Avenues for Future Research**

This research contributes decisively to scholarly understanding of mHealth in the workplace, employing a coordination studies perspective. It also draws on the fields of HIT and health care coordination to provide novel insights. Future research could fruitfully build on these findings in a number of ways as well as transform the research design, scope and theoretical framing (Nicolini, 2010). Others are suggested by the discussion of contributions and limitations in Section 6.4 previously.

7.6.1 Adjusting the Scope of the Research

It has been suggested (Asangansi, 2016) that the implementation of mHealth may lead to conflict with existing HIT systems already embedded in the more bureaucratic health regimes that currently prevail. Other scholar have recently started to examine specific instances of institutional and organisational change associated with mHealth (Ling et al., 2018) and distributed HIT (Bernardi, 2017) implementation. This is an area meriting further investigation because of its important theoretical and practical implications. This research was largely restricted to those clinics where MomConnect is being implemented. One area of research it did not pursue in detail was the response of regional and provincial managers to the reporting facilities of MomConnect, the insight

on local registrations that these responses yield, and how the managers see it in relation to the other management processes that they employ. Informal enquiries at both clinic manager and regional manger levels suggested that this impact is very limited at present.

Research that follows active formal and informal coordination between local sites of mHealth implementation (such as clinics) and other units within the organisation could provide important insights into how mHealth establishes itself and flourishes (or struggles). There are several examples of recent research that address this issue, both in HIT (Bernardi, 2017; Rasmussen, 2018) and mHealth (Ling et al., 2018), that provide a basis for further exploration of this issue.

The examination of contrasting cases is a strong approach for developing explanatory insights (Eisenhardt, 1989). Case studies comparing mHealth coordination between contrasting sites such as urban and rural facilities, or the public and private sectors, could be expected to yield additional insights. This would contribute insight on the extent to which the insights developed in this study are transferable, and what the boundary conditions for transferability are (Busse, Kach, & Wagner, 2017).

The influence of changing national priorities as well as donor funding changes has been documented as an important influence in HIT use (Rasmussen, 2018), resulting in strategies being developed that can accommodate these changes together with planned data management approaches. Thus another aspect that could be explored would be how design choices can shift the relationships between staff at different levels of health care. Institutional logics research has identified this as a potential stumbling block to large-scale implementations (Asangansi & Braa, 2010).

Large-scale mHealth rollouts involving staff interactions are starting to become more prevalent. Survey-based research on mHealth coordination could investigate to what extent the processes uncovered in this case study can be identified across large samples of sites, as well as potentially the conditions under which this takes place. Since this research has identified multiple issues concerning mHealth coordination by staff, more detailed structured interviews or questionnaires could be used to refine the perspective developed here.

7.6.2 Adjusting the Scale of the Research

The focus of this research is on the coordination of mHealth at the local level of the clinic. This is important because large-scale implementation relies on widespread integration with existing work practices. Studies of local coordination need, however, to be complemented by research into the broader organisational linkages that are established or transformed. Such studies are only starting to emerge (Asangansi, 2016; Ling et al., 2018). There is a well-established literature on HIT as large-

scale sociotechnical systems (Braa et al., 2007; Sahay et al., 2009, 2019). However, research explicitly linking mHealth to this is relatively limited (Asangansi & Braa, 2010). Nevertheless the concerns of health infrastructure research, such as scalability (Sahay & Walsham, 2006), standardisation (Braa et al., 2007) and the politics of integrating with existing HIT (Sahay et al., 2009) remain highly relevant to mHealth and merit further investigation.

This research has identified that different health professionals play different roles in the coordination of mHealth in the workplace, with, for example, nurses delegating data entry to health intermediaries and feedback from MomConnect via the district managers – meant to increase accountability of clinic staff to clients – being handled by nurses with no involvement from health intermediaries. A further fruitful avenue of research would be to consider the roles of these different health professionals and intermediaries in more detail. This could yield more systematic insights on how different occupations relate to different types of mHealth technologies.

Empowerment of health care staff using mHealth has been identified in this research as far more complex than the prevalent "techno-optimistic" approach identified by Chib (2013) has allowed for. This research argues that many issues emerging from the cultural-historical setting, not limited to the marginal position of health intermediaries, merit honest and serious engagement in the face of the dilemmas it may pose for implementing organisations seeking to maximise effectiveness with existing resources. There is a body of emerging literature (Anstey Watkins et al., 2018; Bentley et al., 2019; Hampshire et al., 2016) that provides a solid basis for addressing this challenge, of great relevance to scholars concerned with issues of structural inequality in relation to technology.

There are a number of clear issues to be addressed in this line of research. One of the most critical emerging from this research is to engage with how health intermediaries can be empowered on their own terms, taking account of their priorities and needs, within the context of constraints of health system structures and funding levels. Extant scholarship suggests that several options could support this, including non-cash incentives such as political and professional recognition, formal inclusion in the broader health system, and additional skills training to support intermediaries in generating their own income e.g. dispensing medication.

Exploring these options via systematic research would contribute to conceptualising and designing mHealth interventions that are more than technical processes, but rather draw on human relationships and commitment without being exploitive. Ling et al (2018) have noted that Thai health workers were using their own mobile phones and buying prepaid airtime ("credit") at their own expense to improve communication with hospital-based staff such as nurses because of the norms in

Thai culture. These researchers adopt a neutral stance on this practice. Research is lacking on whether practitioners should encourage this form of “informal mHealth”, or develop approaches that treat health professionals and intermediaries as partners in the implementation of the technology, with discretion rather than an obligation to draw on their personal time and finances.

It was noted in Chapter Six that this researcher was not familiar with either the setting of the research or the languages spoken by role-players at all levels. In that chapter, the corrective mechanisms employed to counterbalance this were described. However, it could be fruitful to employ ethnographical and participative research approaches, with researchers fluent in local context and languages. This might provide some contrasting findings, and could certainly enrich the nuance accessed via outside observation and translation.

7.6.3 Following Theoretical Insights

This research has clearly contributed a number of theoretical insights based on the coordination studies perspective, in the form of the constructs of role flexibility and covert routines, as well as problematising the integrating condition of multiple accountability.

Role flexibility was identified as a part of clinic coordination that fell outside of the roles and responsibilities set by the Department of Health. It enabled the manager to make the movement of clients through the clinic more efficient, and was clearly institutionalised as it appeared at all the clinics under study. This is a form of “street-level bureaucracy” (Lipsky, 2010) developed unofficially but a very real and effective measure nonetheless.

Further study of healthcare workplaces could yield further insights as to the conditions under which this occurs, and how it can affect the uptake and coordination of mHealth. Some research exists on how clinic managers respond to changing demands in relation to technology implementation from their head office, but this is limited to the field of HIT (Rasmussen, 2018). Examining the linkage between clinic level- and intra-organisational flexibility is also a promising avenue of research for further elaborating the coordination studies perspective.

Covert routines are of relevance to theory and practice. The findings in this case study suggest that there is probably a variety of covert routines (implicitly sanctioned and unsanctioned) active in health care workplaces where mHealth is implemented. Some of these will be beneficial for mHealth in terms of overcoming obstacles to implementation, but are possibly not sustainable. Others, involving health intermediaries and implicitly, health managers, are concerned with pragmatically managing trade-offs and ensuring that the competing demands of mHealth and other clinic responsibilities.

The three integrating conditions of accountability, predictability and common understanding of the coordination studies perspective (see Figure 1) form powerful principles for examining coordination in other field settings. These principles provided the basis for identifying the phenomenon of multiple accountability. This phenomenon is particularly important on the level of practice because after returning to the literature it is clearly evident not only from mHealth (Anstey Watkins et al., 2018; Hampshire et al., 2016; Kumar et al., 2015) but also from empirical scholarship on health intermediaries (Maes & Kalofonos, 2013; Mottiar & Lodge, 2018).

7.7 Concluding Reflections: The Imperative of Coordination

This research commenced at a time of optimism for the future of mHealth in developing countries, and MomConnect was launched with the support of a number of international aid agencies, with USAID playing a prominent role. MomConnect has now been running for more than six years, but it is not yet clear whether funding has been secured for the long-term continuation of the project. International aid flows have diminished dramatically with the election of increasingly inward-focussed administrations in the US and UK, which may impact on the sustainability of the project.

The downgrade of the outlook for the South African economy by international ratings agencies from “investment grade” to “junk status” poses further questions around the internal financing available for mHealth projects (Gumede, 2017). The 2018 budget speech by the South African Minister of Finance referred to an additional sum of R4.2 billion that would be made available for the implementation of the NHI (Cullinan, 2018). Questions remain about whether the state will be able to negotiate successfully with the powerful private health sector to obtain its support, and it is unclear how well the state can manage relationships with the private medical professionals necessary to help implement the expanded and enhanced services promised by the NHI (Health-E News, 2018). Recent scandals in various provincial Health Departments (Daily Maverick, 2017) suggest that it will require sustained effort to overcome these challenges.

The spread of the COVID-19 virus to South Africa in 2020 has lead to the formal identification of teams of health intermediaries as a key part of efforts to contain the epidemic (Nicolson, 2020). The issues identified in this research of their lack of their integration with the existing health system and precarious terms of employment have been thrown in to stark relief by this development (Gasa, 2020). The crisis conditions raised by the epidemic may however lead to improved coordination and integration of health intermediaries because their importance of their roles as responsible both to the PHC clinic and to the community more broadly may now be more officially recognised.

A clinic that was one of the research sites for this study displayed the plaques shown in Figure 19 near its entrance. These underline how, in a context of uncertainty about the continued stability of foreign donor support, better strategies for project sustainability based on resources already within the health system will be more relevant than ever. This will require the mHealth sector, and the aid agencies that often fund its non-commercial developments, to become more sensitive to the need for increased coordination with existing health systems and the ethical implications of their efforts. This chapter, and this research overall, present one contribution towards enhancing such coordination.

Figure 19 Plaques near the Entrance of a Clinic indicating Funding Sources (Researcher's photograph)

REFERENCES

A set of principles for conducting and evaluating interpretive field studies in information systems. (1999). *Management Information Systems Quarterly*, *23*(1), 67–93.

Aanestad, M., & Jensen, T. B. (2011). Building nation-wide information infrastructures in healthcare through modular implementation strategies. *Journal of Strategic Information Systems*, *20*(2), 161–176.

Adeagbo, O., Herbst, C., Blandford, A., McKendry, R., Estcourt, C., Seeley, J., & Shahmanesh, M. (2019). Exploring people's candidacy for mobile health-supported HIV testing and care services in rural kwaZulu-Natal, South Africa: Qualitative study. *Journal of Medical Internet Research*, *21*(11), 1–13.

Agarwal, R., Gao, G., DesRoches, C., & Jha, A. K. (2010). Research Commentary--The Digital Transformation of Healthcare: Current Status and the Road Ahead. *Information Systems Research*, *21*(4), 796–809.

Agarwal, S., Perry, H. B., Long, L. A., & Labrique, A. B. (2015). Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: Systematic review. *Tropical Medicine and International Health*, *20*(8), 1003–1014.

Akhlaghpour, S., Wu, J., Lapointe, L., & Pinsonneault, A. (2013). The ongoing quest for the IT artifact: Looking back, moving forward. *Journal of Information Technology*, *28*(2), 150–166.

Alberta Doctors Digest. (2005). Alternate relationship plans: New principles and procedures. *Alberta Doctors Digest*, *January/Fe*, 9–10.

Al-Dorzi, H. M., Tamim, H. M., Cherfan, A., Hassan, M. a, Taher, S., & Arabi, Y. M. (2011). Impact of computerized physician order entry (CPOE) system on the outcome of critically ill adult patients: A before-after study. *BMC Medical Informatics and Decision Making*, *11*, 71.

Allen, D. (1997). The nursing-medical boundary: A negotiated order? *Sociology of Health and Illness*, *19*(4), 498–520.

Allen, D. K., Brown, A., Karanasios, S., & Norman, A. (2013). How should technology-mediated organizational change be explained? A comparison of the contributions of Critical Realism and Activity Theory. *MIS Quarterly*, *37*(3), 835–854.

Allen, D. K., Wilson, T. D., Norman, A. W. T., & Knight, C. (2008). Information on the move: The use of mobile information systems by UK police forces. *Information Research*, *13*(4).

Alvesson, M., & Kärreman, D. (2007). Constructing mystery: Empirical matters in theory development. *Academy of Management Review*, *32*(4), 1265–1281.

Andersen, H. M. (2004). "Villagers": Differential treatment in a Ghanaian hospital. *Social Science & Medicine*, *59*(10), 2003–12.

Andrade, A. D. (2009). Interpretive research aiming at theory building: Adopting and adapting the case study design. *The Qualitative Report*, *14*(1), 42–60.

Andrade, A. D., & Urquhart, C. (2010). The affordances of actor network theory in ICT for development research. *Information Technology and People*, *23*(4), 352–374.

Anstey Watkins, J. O. T., Goudge, J., Gómez-Olivé, F. X., & Griffiths, F. (2018). Mobile phone use among patients and health workers to enhance primary healthcare: A qualitative study in rural South Africa. *Social Science & Medicine*, *198*(August 2017), 139–147.

Anteby, M., Chan, C. K., & DiBenigno, J. (2015). Three lenses on occupations and professions in organizations: Becoming, doing, and relating. *The Academy of Management Annals*, *10*(1), 183–244.

Arnold, D., & Bongiovi, J. R. (2013). Precarious, Informalizing, and Flexible Work: Transforming Concepts and Understandings. *American Behavioral Scientist*, *57*(3), 289–308.

Arnold, M. (2003). On the phenomenology of technology: The "Janus-faces" of mobile phones. *Information and Organization*, *13*(4), 231–256.

Asangansi, I. (2012). Understanding HMIS implementation in a developing country Ministry of Health

context - An institutional logics perspective. *Online Journal of Public Health Informatics*, *4*(3).

Asangansi, I. (2016). Is mHealth disrupting the status quo? Evidence from implementations highlighting network versus hierarchical institutional logics. *Electronic Journal of Information Systems in Developing Countries*, *72*(7), 1–27.

Asangansi, I., & Braa, K. (2010). The emergence of mobile-supported national health information systems in developing countries. *Studies in Health Technology and Informatics*, *160*, 540–544.

Associated Press. (2014). Germany bans managers from calling or emailing staff after work hours. Retrieved October 18, 2019, from https://www.news18.com/news/buzz/germany-bans-managers-from-calling-or-emailing-staff-after-work-hours-677249.html

Atkinson, P. (2018). The Spirit of Abduction. *Contemporary Sociology*, *47*(4), 415–417.

Atlas.ti. (2015). Berlin: Atlas.ti GmbH.

Austin-Evelyn, K., Rabkin, M., MacHeka, T., Mutiti, A., Mwansa-Kambafwile, J., Dlamini, T., & El-Sadr, W. M. (2017). Community health worker perspectives on a new primary health care initiative in the Eastern Cape of South Africa. *PLoS ONE*, *12*(3), 1–13.

Azad, B., & King, N. (2008). Enacting computer workaround practices within a medication dispensing system. *European Journal of Information Systems*, *17*(3), 264–278.

Azad, B., & King, N. (2012). Institutionalized computer workaround practices in a Mediterranean country: An examination of two organizations. *European Journal of Information Systems*, *21*(4), 358–372.

Bailey, D. E., Leonardi, P. M., & Chong, J. (2010). Minding the gaps: Understanding technology interdependence and coordination in knowledge work. *Organization Science*, *21*(3), 713–730.

Bardram, J. E. (2000). Temporal coordination: On time and coordination of collaborative activities at a surgical department. *Computer Supported Cooperative Work*, *9*, 157–187.

Barley, S. R. (1986). Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments. *Administrative Science Quarterly*, *31*(1), 78–108.

Barrett, A. K., & Stephens, K. K. (2016). Making Electronic Health Records (EHRs) work: Informal talk and workarounds in healthcare organizations. *Health Communication*.

Barrett, M., & Walsham, G. (2004). Making contributions from interpretive case studies: Examining processes of construction and use. In B. M. Kaplan, D. P. Truex, D. Wastell, A. T. Wood-Harper, & J. I. DeGross (Eds.), *In Information systems research. Relevant theory and informed practice. IFIP TC8/WG8.2 20th year retrospective -- Looking forward from a 20-year perspective on IS research, July 15-17, 2004, Manchester, United Kingdom.* (pp. 293–312). Manchester, United Kingdom: Kluwer Academic Publishers.

Barron, P. (2016). MomConnect: Overview. Sandton, Johannesburg: eHealth Alive Conference.

Barron, P., Peter, J., LeFevre, A. E., Sebidi, J., Bekker, M., Allen, R., … Pillay, Y. (2018). Mobile health messaging service and helpdesk for South African mothers (MomConnect): History, successes and challenges. *BMJ Global Health*, *3*, 1–6.

Barron, P., Pillay, Y., Fernandes, A., Sebidi, J., & Allen, R. (2016). The MomConnect mHealth initiative in South Africa: Early impact on the supply side of MCH services. *Journal of Public Health Policy*, *37*(2), S201–S212.

Basinga, P., Gertler, P. J., Binagwaho, A., Soucat, A. L., Sturdy, J., & Vermeersch, C. M. (2011). Effect on maternal and child health services in Rwanda of payment to primary health-care providers for performance: An impact evaluation. *The Lancet*, *377*(9775), 1421–1428.

Basole, R. C. (2008). Enterprise mobility: Researching a new paradigm. *Information Systems Knowledge Management*, *7*, 1–7.

Battilana, J., & Dorado, S. (2010). Building sustainable hybrid organizations: The case of commercial microfinance organizations. *Academy of Management Journal*, *53*(6), 1419–1440.

Battilana, J., & Lee, M. (2014). Advancing Research on Hybrid Organizing - Insights from the Study of Social Enterprises. *Academy of Management Annals*, *8*(1), 397–441.

Bechky, B. (2006). Gaffers, gofers, and grips: Role-based coordination in temporary organizations. *Organization Science*, *17*(1), 3–21.

Bechky, B. A. (2011). Making organizational theory work: Institutions, occupations, and negotiated orders. *Organization Science*, *22*(5), 1157–1167.

Behfar, K., & Okhuysen, G. A. (2018). Discovery within validation logic: Deliberately surfacing, complementing, and substituting abductive reasoning in hypothetico-deductive inquiry. *Organization Science*, *29*(2), 323–340.

Belle Brown, J., Lewis, L., Ellis, K., Stewart, M., Freeman, T. R., & Kasperski, M. J. (2009). Mechanisms for communicating within primary health care teams. *Canadian Family Physician*, *55*, 1216–1222.

Benbasat, I. (2007). Quo vadis, TAM. *Journal of the Association for Information Systems*, *8*(4), 211–218.

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of Information Systems. *Management Information Systems Quarterly*, *11*(3), 369–386.

Bentley, C. M., Chib, A., & Poveda, S. (2019). A critical narrative approach to openness: The impact of open development on structural transformation. *Information Systems Journal*, *29*(4), 787–810.

Beratarrechea, A., Lee, A. G., Willner, J. M., Jahangir, E., Ciapponi, A., & Rubinstein, A. (2014). The impact of mobile health interventions on chronic disease outcomes in developing countries: A systematic review. *Telemedicine and E-Health*, *20*(1), 75–82.

Berg, M. (1999). Accumulating and coordinating: Occasions for information technologies in medical work. *Computer Supported Cooperative Work*, *8*(4), 373–401.

Berg, M., & Bowker, G. C. (1997). The multiple bodies of the medical record: Toward a sociology of an artifact. *The Sociological Quarterly*, *38*(3), 513–537.

Bernardi, R. (2017). Health information systems and accountability in Kenya: A structuration theory perspective. *Journal of the Association for Information Systems*, *18*(12), 931–957.

Betjeman, T. J., Soghoian, S. E., & Foran, M. P. (2013). mHealth in Sub-Saharan Africa. *International Journal of Telemedicine and Applications*, *6*, 1–7.

Bezuidenhout, A., & Buhlungu, S. (2011). From Compounded to Fragmented Labour: Mineworkers and the Demise of Compounds in South Africa. *Antipode*, *43*(2), 237–263.

Bloom, G., Berdou, E., Standing, H., Guo, Z., & Labrique, A. (2017). ICTs and the challenge of health system transition in low and middle-income countries. *Globalization and Health*, *13*(1), 1–10.

Bødker, S., & Klokmose, C. N. (2011). The Human–Artifact Model: An Activity Theoretical Approach to Artifact Ecologies. *Human–Computer Interaction*, *26*(4), 315–371.

Bodolica, V., & Spraggon, M. (2014). Clinical governance infrastructures and relational mechanisms of control in healthcare organizations. *Journal of Health Management*, *16*(2), 183–198.

Boillat, T., Lienhard, K., & Legner, C. (2015). Entering the world of individual routines: The affordances of mobile applications. In *Proceedings of the International Conference on Information Systems*. Fort Worth: AIS.

Boland, R. J., Lyytinen, K., & Yoo, Y. (2007). Wakes of innovation in project networks: The case of digital 3-D representations in architecture, engineering, and construction. *Organization Science*, *18*(4), 631–647.

Bossen, C., & Foss, M. (2016). The collaborative work of hospital porters: Accountability, visibility and configurations of work. *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing - CSCW '16*, 963–977.

Bossen, C., & Markussen, R. (2010). Infrastructuring and ordering devices in health care: Medication plans and practices on a hospital ward. *Computer Supported Cooperative Work*, *19*(6), 615–637.

Boudreau, M.-C., & Robey, D. (2005). Enacting integrated Information Technology: A human agency perspective. *Organization Science*, *16*(1), 3–18.

Bourgeault, I. L., & Mulvale, G. (2006). Collaborative health care teams in Canada and the USA: Confronting the structural embeddedness of medical dominance. *Health Sociology Review*,

15(5), 481–495.

Braa, J., Hanseth, O., Heywood, A., Mohammed, W., & Shaw, V. (2007). Developing health information systems in developing countries: The flexible standards strategy. *MIS Quarterly*, *31*(2), 381–402.

Braa, J., & Hedberg, C. (2002). The struggle for district-based Health Information Systems in South Africa. *The Information Society*, *18*(2), 113–127.

Braa, J., Monteiro, E., & Sahay, S. (2004). Networks of action: Sustainable health information systems across developing countries. *MIS Quarterly*, *28*(3), 337–362.

Braa, K., & Sanner, A. (2011). Making mHealth Happen for Health Information Systems in Low Resource Contexts. In *Proceedings of the 11th International Conference on Social Implications of Computers in Developing Countries, Kathmandu, Nepal, May 2011*. Kathmandu, Nepal.

Braun, R., Catalani, C., Wimbush, J., & Israelski, D. (2013). Community health workers and mobile technology: A systematic review of the literature. *PLoS ONE*, *8*(6), 4–9.

Breier, M., Wildschut, A., & Mgqolozana, T. (2009). *Nursing in a new era: The profession and education of nurses in South Africa*. Cape Town: HSRC Press.

Bruscaglioni, L. (2016). Theorizing in Grounded Theory and creative abduction. *Quality & Quantity*, *50*(5), 2009–2024.

Burrell, J., & Toyama, K. (2009). What constitutes good ICTD research? *Information Technologies and International Development*, *5*(3), 82–94.

Busse, C., Kach, A. P., & Wagner, S. M. (2017). *Boundary conditions: What they are, how to explore them, why we need them, and when to consider them*. *Organizational Research Methods* (Vol. 20).

Bygstad, B., Hanseth, O., & Le, D. T. (2015). From IT silos to integrated solutions. A study in e-Health complexity. In *European Conference on Information Systems. Münster, Germany.* (pp. 1–15).

Bygstad, B., & Munkvold, B. E. (2011). Exploring the role of informants in interpretive case study research in IS. *Journal of Information Technology*, *26*(1), 32–45.

Byrkjeflot, H., & Jespersen, P. K. (2014). Three conceptualizations of hybrid management in hospitals. *International Journal of Public Sector Management*, *27*(5), 441–458.

Callaghan, M., Ford, N., & Schneider, H. (2010). A systematic review of task- shifting for HIV treatment and care in Africa. *Human Resources for Health*, *8*, 8.

Callinicos, L. (1980). *Gold and Workers 1886 - 1924*. Johannesburg: Ravan Press.

Campbell, M. L., & Rankin, J. M. (2017). Nurses and electronic health records in a Canadian hospital: Examining the social organisation and programmed use of digitised nursing knowledge. *Sociology of Health and Illness*, *39*(3), 365–379.

Campbell, S. W. (2019). From frontier to field: Old and new theoretical directions in mobile communication studies. *Communication Theory*, *29*(1), 46–65.

Cavaye, A. L. M. (1996). Case study research: A multi-faceted research approach for IS. *Information Systems Journal*, *6*(3), 227–242.

Chandhanayingyong, C., Tangtrakulwanich, B., & Kiriratnikom, T. (2007). Teleconsultation for emergency orthopaedic patients using the multimedia messaging service via mobile phones. *Journal of Telemedicine and Telecare*, *13*(4), 193–196.

Chaouiya, C., Liberopoulos, G., & Dallery, Y. (2000). The extended kanban control system for production coordination of assembly manufacturing systems. *IIE Transactions*, *32*, 999–1012.

Charmaz, K. (2014). *Constructing Grounded Theory* (2nd Editio). London: Sage Publications Ltd.

Charmaz, K., & Mitchell, R. G. (1996). The myth of silent authorship: Self, substance, and style in ethnographic writing. *Symbolic Interaction*, *19*(4), 285–302.

Chhoun, P., Kaplan, K. C., Wieten, C., Jelveh, I., Lienemann, M., Tuot, S., … Brody, C. (2019). Using participatory methods to build an mHealth intervention for female entertainment workers in Cambodia: the development of the Mobile Link project. *mHealth*, *5*(24).

Chib, A. (2013). The promise and peril of mHealth in developing countries. *Mobile Media &*

Communication, *1*(1), 69–75.

Chib, A., & Chen, V. H. (2011). Midwives with mobiles: A dialectical perspective on gender arising from technology introduction in rural Indonesia. *New Media & Society*, *13*(3), 486–501.

Chib, A., Cheong, Y. J., Lee, L. C. L., Ng, C. H. C., Tan, K. C., & Vlv, K. (2012). The hope of mobile phones in Indian rural healthcare. *Journal of Health Informatics in Developing Countries*, *6*(1), 406–421.

Chib, A., Law, F. B. M. I., Ahmad, M. N., & Ismail, N. B. M. (2012). Moving mountains with mobiles: Spatiotemporal perspectives on mHealth in Nepal. *MedieKultur: Journal of Media and Communication Research*, *28*(52), 100–114.

Chib, A., & Lin, S. H. (2018). Theoretical advancements in mHealth: A systematic review of mobile apps. *Journal of Health Communication*, *23*(10-11), 909–955.

Chib, A., Lwin, M. O., Ang, J., Lin, H., & Santoso, F. (2008). Midwives and mobiles: Using ICTs to improve healthcare in Aceh Besar, Indonesia. *Asian Journal of Communication*, *18*(4), 348–364.

Chib, A., Lwin, M. O., & Jung, Y. (2009). Adoption of mobile phones to enhance healthcare: A technology acceptance study of maternal care workers in Indonesia. *Media Asia*, *36*(4), 216–222.

Chib, A., van Velthoven, M. H., & Car, J. (2015). mHealth adoption in low-resource environments: A review of the use of mobile healthcare in developing countries. *Journal of Health Communication*, *20*(1), 4–34.

Chib, A., Wilkin, H., & Hua, S. (2013). International migrant workers' use of mobile phones to seek social support in Singapore. *Information Technologies & International Development*, *9*(4), pp. 19–34.

Chipps, J., Pimmer, C., Brysiewicz, P., Walters, F., Linxen, S., Ndebele, T., & Gröhbiel, U. (2015). Using mobile phones and social media to facilitate education and support for rural-based midwives in South Africa. *Curationis*, *38*(2), 1–8.

Chopra, M., Lawn, J. E., Sanders, D., Barron, P., Abdool Karim, S. S., Bradshaw, D., … Coovadia, H. (2009). Achieving the health Millennium Development Goals for South Africa: Challenges and priorities. *The Lancet*, *374*(9694), 1023–31.

Chowles, T. (2014). Tier.Net Gets Global Interest - eHealth News ZA. Retrieved December 13, 2016, from http://ehealthnews.co.za/tier-net-global-2/

Clarke, M., Dick, J., & Lewin, S. (2008). Community health workers in South Africa: Where in this maze do we find ourselves? *SAMJ*, *98*(9), 680–681.

Coovadia, H., Jewkes, R., Barron, P., Sanders, D., & McIntyre, D. (2009). The health and health system of South Africa: Historical roots of current public health challenges. *The Lancet*, *374*(9692), 817–834.

Cornwall, A., & Shankland, A. (2008). Engaging citizens: Lessons from building Brazil's national health system. *Social Science & Medicine*, *66*(10), 2173–2184.

Crankshaw, T., Corless, I. B., Giddy, J., Nicholas, P. K., Eichbaum, Q., & Butler, L. M. (2010). Exploring the patterns of use and the feasibility of using cellular phones for clinic appointment reminders and adherence messages in an antiretroviral treatment clinic, Durban, South Africa. *AIDS Patient Care and STDs*, *24*(11), 729–734.

Crowston, K. (1997). A coordination theory approach to organizational process design. *Organization Science*, *8*(2), 157–175.

Cullinan, K. (2018). Budget 2018: NHI gets cash – But its operations remain vague. Retrieved March 8, 2020, from https://www.dailymaverick.co.za/article/2018-02-22-budget-2018-nhi-gets-cash-but-its-operations-remain-vague/

Currie, G., Lockett, A., Finn, R., Martin, G., & Waring, J. (2012). Institutional work to maintain professional power: Recreating the model of medical professionalism. *Organization Studies*, *33*(7), 937–962.

Daily Maverick. (2017). Health-E News: Grim findings after health facilities are inspected. Retrieved

April 18, 2017, from https://www.dailymaverick.co.za/article/2017-04-18-health-e-grim-findings-after-health-facilities-are-inspected/#.WPW0NEclHQo

Darke, P., Shanks, G., & Broadbent, M. (1998). Successfully completing case study research: Combining rigour, relevance and pragmatism. *Information Systems Journal*, *8*(4), 273–289.

Daviaud, E. (2008). How much is not enough? Human resources requirements for primary health care: A case study from South Africa. *Bulletin of the World Health Organization*, *86*, 46–51.

Davison, R. M., & Martinsons, M. G. (2016). Context is king! Considering particularism in research design and reporting. *Journal of Information Technology*, *31*(3), 241–249.

De Costa, A., & Diwan, V. (2007). "Where is the public health sector?". Public and private sector healthcare provision in Madhya Pradesh, India. *Health Policy*, *84*(2-3), 269–276.

de Guinea, A. O., & Markus, M. L. (2009). Why break the habit of a lifetime? Rethinking the roles of intention, habit and emotion in continuing information technology use. *MIS Quarterly*, *33*(3), 433–444.

de la Harpe, R., Lotriet, H., Pottas, D., & Korpela, M. (2013). Socio-technical approach to community health: Designing and developing a mobile care data application for home-based healthcare, in South Africa. *The Journal of Community Informatics*, *9*(2), 1–9.

de Vos, P. (2011, August). Why provinces have little real power but huge responsibilities. Retrieved April 17, 2020, from https://constitutionallyspeaking.co.za/why-provinces-have-little-real-power-but-huge-responsibilities/

Digby, A. (2008). The Medical History of South Africa: An Overview. *History Compass*, *6*(5), 1194–1210.

Dobson, J. A., & Nicholson, B. (2017). Exploring the dialectics underlying institutionalization of IT artifacts. *Journal of the Association for Information Systems*, *18*(12), 848–871.

Doolin, B. (2004). Power and resistance in the implementation of a medical management information system. *Information Systems Journal*, *14*(4), 343–362.

Doolin, B., & Lowe, A. (2002). To reveal is to critique: Actor-Network Theory and critical information systems research. *Journal of Information Technology*, *17*(2), 69–78.

Dopson, S., Fitzgerald, L., & Ferlie, E. (2008). Understanding change and innovation in healthcare settings: Reconceptualizing the active role of context. *Journal of Change Management*, *8*(3-4), 213–231.

Dourish, P. (2003). The appropriation of interactive technologies. *Computer Supported Cooperative Work*, *12*(4), 465–490.

Dourish, P. (2004a). What we talk about when we talk about context. *Personal and Ubiquitous Computing*, *8*(1), 19–30.

Dourish, P. (2004b). *Where the Action Is: The Foundations of Embodied Interaction* (First Pape). Cambridge, Massachusetts: MIT Press.

Dyer, W. G., & Wilkins, A. L. (1991). Better stories, not better constructs, to generate better theory: A rejoinder to Eisenhardt. *Academy of Management Review*, *16*(3), 613–619.

e-Government as a Carrier of Context. (2005). *Journal of Public Policy*, *25*(1), 51–74.

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review*, *14*(4), 532.

Ellingsen, G., & Monteiro, E. (2003). A patchwork planet: Integration and cooperation in hospitals. *Computer Supported Cooperative Work*, *12*, 71–95.

Engeström, Y. (1993). Developmental studies of work as a testbench of activity theory: The case of primary care medical practice. In S. Chaiklin & J. Lave (Eds.), *Understanding Practice: Perspectives on Activity and Context* (pp. 64–103). Cambridge: Cambridge University Press.

Engeström, Y. (1995). Objects, contradictions and collaboration in medical cognition: An activity-theoretical perspective. *Artificial Intelligence in Medicine*, *7*, 395–412.

Engeström, Y. (1999). Activity Theory and individual and social transformation. In Y. Engeström, R. Miettinen, & R.-L. Punamaki (Eds.), *Perspectives on Activity Theory* (pp. 19 – 38). Cambridge

University Press.
Faraj, S., & Xiao, Y. (2006). Coordination in fast-response organizations. *Management Science*, *52*(8), 1155–1169.
Fayol, H. (1949). *General and industrial management*. London, UK: Sir Isaac Pitman & Sons, Ltd.
Fereday, J., Adelaide, N., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 80–92.
Ferguson, J. (2007). *The Anti-Politics Machine* (Eighth Edi). Minneapolis and London: University of Minnesota Press.
Ferlie, E., Fitzgerald, L., Wood, M., & Hawkins, C. (2005). The nonspread of innovations: The mediating role of professionals. *Academy of Management Journal*, *48*(1), 117–134.
Fiordelli, M., Diviani, N., & Schulz, P. J. (2013). Mapping mHealth research: A decade of evolution. *Journal of Medical Internet Research*, *15*(5), e95.
Fitzgerald, G., & Russo, N. L. (2005). The turnaround of the London Ambulance Service Computer-Aided Despatch system (LASCAD). *European Journal of Information Systems*, *14*(3), 244–257.
Fitzpatrick, G., & Ellingsen, G. (2013). A Review of 25 Years of CSCW Research in Healthcare: Contributions, Challenges and Future Agendas. *Computer Supported Cooperative Work*, *22*(4-6), 609–665.
Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219–245.
Forrest, J. I., Wiens, M., Kanters, S., Nsanzimana, S., Lester, R. T., & Mills, E. J. (2015). Mobile health applications for HIV prevention and care in Africa. *Current Opinion in HIV and AIDS*, *10*(6), 464–471.
Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., … Haines, A. (2013). The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: A systematic review. *PLoS Medicine*, *10*(1).
Furukawa, M. F. M., King, J., Patel, V., Hsiao, C.-J. C.-J., Adler-Milstein, J., Jha, A., & Ashish, K. (2014). Despite substantial progress in EHR adoption, health information exchange and patient engagement remain low in office settings. *Health Affairs*, *33*(9), 1672–1679.
Garrib, A., Stoops, N., Mckenzie, A., Dlamini, L., Govender, T., Rohde, J., & Herbst, K. (2008). An evaluation of the District Health Information System in rural South Africa. *South African Medical Journal*, *98*(7), 549–552.
Garritty, C., & El Emam, K. (2006). Who's using PDAs? Estimates of PDA use by health care providers: a systematic review of surveys. *Journal of Medical Internet Research*, *8*(2), e7.
Gasa, S. (2020, March). Covid-19: Community healthcare frontliners left out of planning and training, says nurses union. Retrieved April 13, 2020, from https://www.dailymaverick.co.za/article/2020-03-24-covid-19-community-healthcare-frontliners-left-out-of-planning-and-training-says-nurses-union/
Georgeu, D., Colvin, C. J., Lewin, S., Fairall, L., Bachmann, M. O., Uebel, K., … Bateman, E. D. (2012). Implementing nurse-initiated and managed antiretroviral treatment (NIMART) in South Africa: A qualitative process evaluation of the STRETCH trial. *Implementation Science*, *7*, 66.
Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structuration*. London: Polity Press.
Gittell, J. H. (2002). Coordinating mechanisms in care provider groups: Relational coordination as a mediator and input uncertainty as a moderator of performance effects. *Management Science*, *48*(11), 1408–1426.
Gittell, J. H., Godfrey, M., & Thistlethwaite, J. (2013). Interprofessional collaborative practice and relational coordination: Improving healthcare through relationships. *Journal of Interprofessional Care*, *27*(3), 210–213.
Gittell, J. H., Seidner, R., & Wimbush, J. (2010). A relational model of how high-performance work

systems work. *Organization Science*, *21*(2), 490–506.

Gkeredakis, M., & Constantinides, P. (2019). Phenomenon-based problematization: Coordinating in the digital era. *Information and Organization*, *29*(3).

Global Observatory for eHealth. (2016). *Global diffusion of eHealth: Making universal health coverage achievable. Report of the third global survey on eHealth*. Geneva.

Goh, J. M., Gao, G. (Gordon), & Agarwal, R. (2011). Evolving work routines: Adaptive routinization of information technology in healthcare. *Information Systems Research*, *22*(3), 565–585.

Goodwin, J. (2017). Did you know: 15 things that happen to the body past the due date. Retrieved February 18, 2020, from https://www.babygaga.com/15-things-that-happen-to-the-body-past-the-due-date/

Gregor, S. (2014). Theory - Still king but needing a revolution. *Journal of Information Technology*, *29*(4), 337–340.

Grossman-Kahn, R., Schoen, J., Mallett, J. W., Brentani, A., Kaselitz, E., & Heisler, M. (2017). Challenges facing community health workers in Brazil's Family Health Strategy: A qualitative study. *The International Journal of Health Planning and Management*, *Early View*.

GSMA Intelligence. (2018). *GSMA Mobile Economy 2018*. London.

Gumede, A. (2017, November). S&P Cuts South Africa Debt Rating, Moody's Issues Warning. *Bloomberg.com*.

Haas, S. (2016). *mHealth Compendium. Special Edition 2016: Reaching Scale*. Arlington, VA.

Hampshire, K., Porter, G., Mariwah, S., Munthali, A., Robson, E., Owusu, S. A., … Milner, J. (2016). Who bears the cost of "informal mHealth"? Health-workers' mobile phone practices and associated political-moral economies of care in Ghana and Malawi. *Health Policy and Planning*, (July 2016), czw095.

Han, C. (2018). Precarity, Precariousness, and Vulnerability. *Annual Review of Anthropology*, *47*, 331–343.

Hanmer, L. (1999). Criteria for the evaluation of district health information systems. *International Journal of Medical Informatics*, *56*(1-3), 161–8.

Hanseth, O., & Lyytinen, K. (2010). Information infrastructures: The case of building internet. *Journal of Information Technology*, *25*(1), 1–19.

Hanseth, O., Thoresen, K., & Winner, L. (1994). The politics of networking technology in health care. *Computer Supported Cooperative Work*, *2*(1-2), 109–130.

Harris, J. B., Hatwiinda, S. M., Randels, K. M., Chi, B. H., Kancheya, N. G., Jham, M. A., … Reid, S. E. (2008). Early lessons from the integration of tuberculosis and HIV services in primary care centers in Lusaka, Zambia. *International Journal of Tubercular and Lung Disease*, *12*(7), 773–779.

Harris, M. A., Patten, K., & Regan, E. (2013). The need for BYOD mobile device security awareness and training. In *Americas Conference on Information Systems, AMCIS 2013* (p. 11). Chicago, Illinois.

Health-E News. (2018). NHI White Paper doesn't explain how it will get buy-in from private doctors. Retrieved January 29, 2018, from http://www.dailymaverick.co.za/article/2015-12-13-health-e-news-nhi-white-paper-doesnt-explain-how-it-will-get-buy-in-from-private-doctors/#.V1QJEPl97RY

Heath, C., & Luff, P. (1996). Documents and professional practice: " Bad " organisational reasons for " good " clinical records. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work* (pp. 354–363).

Heeks, R. (2006). Health information systems: Failure, success and improvisation. *International Journal of Medical Informatics*, *75*(2), 125–37.

Hilligoss, B., Song, P. H., & McAlearney, A. S. (2016). Coordination mechanisms in four accountable care organizations. *International Journal of Organization Theory and Behavior*, *19*(2), 207–232.

Hollan, J., Hutchins, E., & Kirsh, D. (2000). Distributed cognition: Toward a new foundation for

Human-Computer Interaction research. *ACM Transactions on Computer-Human Interaction*, *7*(2), 174 –196.

Huang, F., Blaschke, S., & Lucas, H. (2017). Beyond pilotitis: Taking digital health interventions to the national level in China and Uganda. *Globalization and Health*, *13*(1), 1–11.

Hunter, Q. (2018, May 14). After a damning report and takeover by the national government, Mahumapelo attempts brutal fightback. *Daily Maverick*.

Hupe, P., & Hill, M. (2007). Street-Level Bureaucracy and Public Accountability. *Public Administration*, *85*(2), 279–299.

Hussain, Z. I., & Cornelius, N. (2009). The use of domination and legitimation in information systems implementation. *Information Systems Journal*, *19*(2), 197–224.

Igira, F., & Aanestad, M. (2009). Living with contradictions: Complementing Activity Theory with the notion of "installed base" to address the historical dimension of transformation. *Mind, Culture, and Activity*, *16*(3), 209–233.

Igira, F. T. (2008). *The Interplay between Transformation in Everyday Work Practices and IS Design and Implementation Processes: Empirical Experiences From the Health Information Systems in Tanzania*. University of Oslo, Norway.

International Telecommunications Union. (2020). Development Statistics. Retrieved March 9, 2020, from https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Iribarren, S. J., Brown, W., Giguere, R., Stone, P., Schnall, R., Staggers, N., & Carballo-Diéguez, A. (2017). Scoping review and evaluation of SMS/text messaging platforms for mHealth projects or clinical interventions. *International Journal of Medical Informatics*, *101*, 28–40.

Jarzabkowski, P. A., Lê, J. K., & Feldman, M. S. (2012). Toward a theory of coordinating: Creating coordinating mechanisms in practice. *Organization Science*, *23*(4), 907–927.

Jembi Health Systems NPC. (2014). National Pregnancy Registry. Retrieved September 23, 2014, from http://www.jembi.org/project/national-pregnancy-registry/

Jensen, T. B., & Aanestad, M. (2007). Hospitality and hostility in hospitals: A case study of an EPR adoption among surgeons. *European Journal of Information Systems*, *16*, 672–680.

Jewkes, R., Abrahams, N., & Mvo, Z. (1998). Why do nurses abuse patients? Reflections from South African obstetric services. *Social Science & Medicine*, *47*(11), 1781–95.

Jobstown.co.za. (2017). Queue marshall: 2 posts. Retrieved April 26, 2020, from https://www.jobstown.co.za/opportunities/queue-marshall-2-posts/

Johns, G. (2017). Reflections on the 2016 decade award: Incorporating context in organizational research. *Academy of Management Review*, *42*(4), 577–595.

Jones, B. M. R., & Karsten, H. (2008). Giddens's Structuration Theory and information systems research. *MIS Quarterly*, *32*(1), 127–157.

Kakihara, M., & Sorensen, C. (2002). Mobility: An Extended Perspective. In *The 35th Annual Hawaii International Conference on System Sciences* (pp. 1–11).

Källander, K., Tibenderana, J. K., Akpogheneta, O. J., Strachan, D. L., Hill, Z., Asbroek, A. H. A. Ten, … Meek, S. R. (2013). Mobile health (mhealth) approaches and lessons for increased performance and retention of community health workers in low and middle-income countries: A review. *Journal of Medical Internet Research*, *15*(1).

Kalleberg, A. L. (2009). Precarious work, insecure workers: Employment relations in transition. *American Sociological Review*, *74*(1), 1–22.

Kalofonos, I. (2014). "All they do is pray": Community labour and the narrowing of "care" during Mozambique's HIV scale-up. *Global Public Health*, *9*(1-2), 7–24.

Kane, G. C., & Labianca, G. J. (2011). IS avoidance in health-care groups: A multilevel investigation. *Information Systems Research*, *22*(3), 504–522.

Kane, S., Kok, M., Ormel, H., Otiso, L., Sidat, M., Namakhoma, I., … de Koning, K. (2016). Limits and opportunities to community health worker empowerment: A multi-country comparative study. *Social Science & Medicine*, *164*, 27–34.

Kaptelinin, V., & Nardi, B. A. (2006). *Acting with technology: Activity Theory and interaction design*. (V. Kaptelinin & K. Foot, Eds.). Cambridge, Massachusetts: MIT Press.

Kaptelinin, V., & Nardi, B. A. (2012). *Activity Theory in HCI: Fundamentals and reflections. Synthesis Lectures in Human-Centered Informatics. 5.1, 1-105*. Morgan and Claypool Publishers.

Kaptelinin, V., Nardi, B., & Macaulay, C. (1999). The Activity Checklist: A Tool for Representing the "Space" of Context. *Interactions*, *July / Aug*, 27–39.

Karanasios, S. (2014). Framing ICT4D research using Activity Theory: A match? *Information Technologies and International Development*, *10*(2), 1–17.

Karanasios, S., & Allen, D. (2014). Mobile technology in mobile work: Contradictions and congruencies in activity systems. *European Journal of Information Systems*, *23*(5), 529–542.

Kautzky, K., & Tollman, S. M. (2008). A Perspective on Primary Health Care in South Africa. In B. P & J. Roma-Reardon (Eds.), *South African Health Review 2008* (pp. 17–30). Durban, South Africa: Health Systems Trust.

Kellogg, K. C. (2019). Subordinate activation tactics: Semi-professionals and micro-level institutional change in professional organizations.

Keutel, M., Michalik, B., & Richter, J. (2013). Towards mindful case study research in IS: A critical analysis of the past ten years. *European Journal of Information Systems*, *23*(3), 256–272.

Kimaro, H. C., & Nhampossa, J. L. (2005). Analyzing the problem of unsustainable health information systems in less-developed economies: Case studies from Tanzania and Mozambique. *Information Technology for Development*, *11*(3), 273–298.

Kimenyi, M. S. (2015). Leapfrogging traditional service delivery constraints in Africa through mobile technologies. Retrieved December 22, 2015, from http://www.brookings.edu/blogs/africa-in-focus/posts/2015/03/11-leapfrogging-africa-mobile-technologies-kimenyi

Kling, R. (1991). Cooperation, coordination and control in computer-supported work. *Communications of the ACM*, *34*(12), 83–88.

Knippenberg, R., Lawn, J. E., Darmstadt, G. L., Begkoyian, G., Fogstad, H., Walelign, N., & Paul, V. K. (2005). Systematic scaling up of neonatal care in countries. *Lancet*, (March), 23–35.

Konde-Lule, J., Gitta, S. N., Lindfors, A., Okuonzi, S., Onama, V. O., & Forsberg, B. C. (2010). Private and public health care in rural areas of Uganda. *BMC International Health and Human Rights*, *10*(1), 29.

Korpela, M., Mursu, A., Soriyan, A., Eerola, A., Häkkinen, H., & Toivanen, M. (2004). Information systems research and development by activity analysis and development: Dead horse or the next wave? In B. Kaplan, D. P. T. III, D. Wastell, A. T. Wood-Harper, & J. I. DeGross (Eds.), *Information Systems Research: Relevant Theory and Informed Practice* (Vol. 143, pp. 453–471). Dordrecht, Netherlands: Kluwer Academic Publishers.

Krauss, K. (2013). Collisions between the worldviews of international ICT policy-makers and a deep rural community in South Africa: Assumptions, interpretation, implementation, and reality. *Information Technology for Development*, *19*(September), 296–318.

Kumar, N., Brunette, W., Dell, N., Perrier, T., Kolko, B., Borriello, G., & Anderson, R. (2015). Understanding sociotechnical implications of mobile health deployments in India, Kenya, and Zimbabwe. *Information Technologies & International Development*, *X*(4), 17–32.

Labrique, A. B., Wadhwani, C., Williams, K. A., Lamptey, P., Hesp, C., Luk, R., & Aerts, A. (2018). Best practices in scaling digital health in low and middle income countries. *Globalization and Health*, *14*(1), 1–8.

Labrique, A., Vasudevan, L., Chang, L. W., & Mehl, G. (2013). H_pe for mHealth: More "y" or "o" on the horizon? *International Journal of Medical Informatics*, *82*(5), 467–469.

Lagomarsino, G., Garabrant, A., Adyas, A., Muga, R., & Otoo, N. (2012). Moving towards universal health coverage: Health insurance reforms in nine developing countries in Africa and Asia. *The Lancet*, *380*(9845), 933–943.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers through Society*. Harvard

University Press.
Latour, B. (1996). *Aramis, or the Love of Technology*. Cambridge, Massachusetts: Harvard University Press.
Latour, B. (2007). *Reassembling the Social: An Introduction to Actor-Network -Theory*. Oxford: Oxford University Press.
Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.
Lee, A. S., & Baskerville, R. L. (2003). Generalizing generalizability in information systems research. *Information Systems Research*, *14*(3), 221–243.
Lee, S. H., Nurmatov, U. B., Nwaru, B. I., Mukherjee, M., Grant, L., & Pagliari, C. (2016). Effectiveness of mHealth interventions for maternal, newborn and child health in low- and middle-income countries: Systematic review and meta-analysis. *Journal of Global Health*, *6*(1).
Leon, N., Schneider, H., & Daviaud, E. (2012). Applying a framework for assessing the health system challenges to scaling up mHealth in South Africa. *BMC Medical Informatics and Decision Making*, *12*, 123.
Leonardi, P. M. (2011). When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. *Management Information Systems Quarterly*, *35*(1), 147 – 167.
Leonardi, P. M. (2013). When does technology use enable network change in organizations? A comparative study of feature use and shared affordances. *MIS Quarterly*, *37*(3), 749–775.
Leonardi, P. M., & Barley, S. R. (2010). What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing. *The Academy of Management Annals*, *4*(1), 1–51.
Lewin, S., & Reeves, S. (2011). Enacting "team" and "teamwork": Using Goffman's theory of impression management to illuminate interprofessional practice on hospital wards. *Social Science & Medicine*, *72*(10), 1595–1602.
Lindberg, K., Erik, B., & Walter, L. (2019). Emergent coordination and situated learning in a hybrid OR: The mixed blessing of using radiation. *Social Science & Medicine*, *228*(March 2018), 232–239.
Ling, R., Poorisat, T., & Chib, A. (2018). Mobile phones and patient referral in Thai rural healthcare: A structuration view. *Information, Communication & Society*.
Lipsky, M. (2010). *Street-Level Bureaucracy* (Updated Ed). New York: Russell Sage Foundation.
Lluch, M. (2011). Healthcare professionals' organisational barriers to health information technologies - A literature review. *International Journal of Medical Informatics*, *80*(12), 849–62.
Mackintosh, N., & Sandall, J. (2010). Overcoming gendered and professional hierarchies in order to facilitate escalation of care in emergency situations: The role of standardised communication protocols. *Social Science & Medicine*, *71*(9), 1683–6.
Maes, K. (2015). "Volunteers are not paid because they are priceless": Community Health Worker capacities and values in an AIDS treatment intervention in urban Ethiopia. *Medical Anthropology Quarterly*, *29*(1), 97–115.
Maes, K., Closser, S., Tesfaye, Y., & Abesha, R. (2019). Psychosocial distress among unpaid community health workers in rural Ethiopia: Comparing leaders in Ethiopia's Women's Development Army to their peers. *Social Science & Medicine*, *230*(October 2018), 138–146.
Maes, K., & Kalofonos, I. (2013). Becoming and remaining community health workers: Perspectives from Ethiopia and Mozambique. *Social Science & Medicine*, *87*, 52–59.
Malan, M. (2014). Analysis: Why policy is failing community health workers. Retrieved April 15, 2017, from http://bhekisisa.org/article/2014-09-04-why-policy-is-failing-community-health-workers/
Malone, T. W., & Crowston, K. (1990). What is Coordination Theory and how can it help design cooperative work systems. In *Proceedings of the Conference on Computer Supported Cooperative Work* (p. 14). Los Angeles.

Malone, T. W., & Crowston, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys (CSUR)*, *26*(1), 87–119.

Manning, P. K. (1996). Information technology in the police context: The "sailor" phone. *Information Systems Research*, *7*(1), 52–62.

Mapham, W. (2008). Mobile phones: Changing health care one SMS at a time. *The Southern African Journal of HIV Medicine*, *Spring*, 11–16.

Markus, M. L., & Lee, A. S. (1999). Special Issue on Intensive Research in Information Systems: Using Qualitative, Interpretive, and Case Methods to Study Information Technology: Foreward. *MIS Quarterly*, *23*(1), 35–38.

Martinez, J., Ro, M., Villa, N. W., Powell, W., & Knickman, J. R. (2011). Transforming the delivery of care in the post-health reform era: What role will community health workers play? *American Journal of Public Health*, *101*(12), 1–5.

Masilela, T. C., Foster, R., & Chetty, M. (2014). The eHealth Strategy for South Africa 2012-2016: How far are we? In A. Padarath & R. English (Eds.), *South African Health Review 2013/2014* (pp. 15–24). Durban, South Africa: Health Systems Trust.

Matavire, R., & Brown, I. (2011). Profiling grounded theory approaches in information systems research. *European Journal of Information Systems*, *22*(1), 119–129.

Matavire, R., & Manda, T. D. (2014). Intervention breakdowns as occasions for articulating mobile health information infrastructures. *Electronic Journal of Information Systems in Developing Countries*, *63*(3), 1–17.

Matusik, S. F., & Mickel, A. E. (2011). Embracing or embattled by converged mobile devices? Users' experiences with a contemporary connectivity technology. *Human Relations*, *64*, 1001–1030.

Maureau, E. A. (2014). *The negotiation of HIV prevention among community HIV educators in KwaZulu - Natal, South Africa*. University of Canterbury.

Mazmanian, M. (2013). Avoiding the trap of constant connectivity: When congruent frames allow for heterogeneous practices. *Academy of Management Journal*, *56*(5), 1225–1250.

Mazmanian, M., Orlikowski, W. J., & Yates, J. (2013). The autonomy paradox: The implications of mobile email devices for knowledge professionals. *Organization Science*, *24*(5), 1337–1357.

Mazur, R. (1988). Book Review. The Surplus People: Forced Removals in South Africa. *Afrcan Studies Review*, *31*(2), 147–149.

McIntyre, D., & Klugman, B. (2016). The human face of decentralisation and integration of health services :Experience from South Africa. *Reproductive Health Matters*, *11*(21), 108–119.

MEASURE Evaluation. (2016). SIFSA partners with eHealth Alive 2016 conference. Retrieved March 8, 2020, from https://www.measureevaluation.org/sifsa/news/sifsa-partners-with-ehealth-alive-2016-conference

Middleton, C., Scheepers, R., & Tuunainen, V. K. (2014). When mobile is the norm: Researching mobile information systems and mobility as post-adoption phenomena. *European Journal of Information Systems*, *23*(5), 503–512.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative Data Analysis* (Third Edit). Los Angeles: Sage Publications Inc.

Millar, R. (2012). Social enterprise in health organisation and management: Hybridity or homogeneity? *Journal of Health Organization and Management*, *26*(2), 143–148.

Mitev, N. (2009). In and out of Actor-Network Theory: A necessary but insufficient journey. *Information Technology and People*, *22*(1), 9–25.

Mobile Alliance for Maternal Action. (2014). MAMA's lessons learned on the way to 500,000 subscribers. Retrieved December 13, 2016, from http://www.mhealthknowledge.org/resources/mamas-lessons-learned-way-500000-subscribers

Mohamed, A. H. H. M., Tawfik, H., Al-Jumeily, D., & Norton, L. (2011). MoHTAM: A Technology Acceptance Model for Mobile Health Applications. *Developments in E-Systems Engineering*, 13–

18.
Montague, E., & Asan, O. (2012). Physician interactions with Electronic Health Records in primary care. *Health Systems*, *1*(2), 96–103.
Monteiro, E., Pollock, N., Hanseth, O., & Williams, R. (2012). From artefacts to infrastructures. *Computer Supported Cooperative Work*.
Mosa, A. S. M., Yoo, I., & Sheets, L. (2012). A systematic review of healthcare applications for smartphones. *BMC Medical Informatics and Decision Making*, *12*(1), 67–98.
Mottiar, S., & Lodge, T. (2018). The role of community health workers in supporting South Africa's HIV/ AIDS treatment programme. *African Journal of AIDS Research*, *17*(1), 54–61.
Mukherjee, A. S. (2015). Understanding empowerment through technology-driven power structures: Case from mother and child tracking system in India. In *Proceedings of the International Conference on Social Implications of Computer in Developing Countries* (pp. 654–664). Negombo, Sri Lanka.
Munkvold, G., Ellingsen, G., & Koksvik, H. (2006). Formalizing work – Reallocating redundancy. In *Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work* (pp. 59–68). ACM.
Nagel, T. (1989). The view from nowhere. New York and Oxford: Oxford University Press.
Naidoo, S. (2012). The South African National Health Insurance: A revolution in health-care delivery! *Journal of Public Health*, *34*(1), 149–150.
Nancy M . Carter. (1986). Review: General and Industrial Management by Henri Fayol. *The Academy of Management Review*, *11*(2), 454–456.
National Department of Health and CSIR. (2014). *National Health Normative Standards Framework for Interoperability in eHealth*. Pretoria, South Africa.
National Department of Health: Republic of South Africa. (2011). *Provincial Guidelines for the Implementation of the Three Streams of PHC Re-Engineering*.
National Department of Health: Republic of South Africa. (2012a). *eHealth Strategy South Africa: 2012-2016*. Pretoria, South Africa.
National Department of Health: Republic of South Africa. (2012b). *National Health Insurance in South Africa: Policy Paper*.
National Department of Health: Republic of South Africa. (2014a). Documents - MomConnect Training Materials. Retrieved February 13, 2020, from http://www.health.gov.za/index.php/mom-connect-docs/category/145-momconnect-provincial-presentations
National Department of Health: Republic of South Africa. (2014b). MomConnect facilitator notes: Training of clinic staff. Pretoria, South Africa.
National Department of Health: Republic of South Africa. (2015a). *Guidelines for maternity care in South Africa. A manual for clinics, community health centres and district hospitals*. Pretoria, South Africa. https://doi.org/978-0-620-66530-8
National Department of Health: Republic of South Africa. (2015b). *mHealth Strategy 2015-2019*. Tshwane: Department of Health. Republic of South Africa.
National Department of Health: Republic of South Africa. (2015c). MomConnect Summary. National Department of Health, Republic of South Africa.
National Department of Health: Republic of South Africa. (2015d). *National Health Insurance for South Africa. Version 4*.
National Department of Health: Republic of South Africa. (2018). *Policy Framework and Strategy for Ward-Based Primary Healthcare Outreach Teams*. Pretoria, South Africa. https://doi.org/978-1920031-98-5
Neupane, S., Odendaal, W., Friedman, I., Jassat, W., Schneider, H., & Doherty, T. (2014). Comparing a paper based monitoring and evaluation system to a mHealth system to support the national community health worker programme, South Africa: An evaluation. *BMC Medical Informatics*

and Decision Making, *14*(1), 69.

Ngwenyama, O. (2019). The ten basic claims of Information Systems Research: An approach to interrogating validity claims in scientific argumentation. *SSRN Electronic Journal*, 1–40.

Nicola, E., Bradshaw, D., Phillips, T., & Dudley, L. (2013). Human factors affecting the quality of routinely collected data in South Africa. In C.U. Lehmann et al (Ed.), *MEDINFO 2013* (p. 5). IMIA and IOS Press.

Nicolini, D. (2010). Zooming in and out: Studying practices by switching theoretical lenses and trailing connections. *Organization Studies*, *30*(12), 1391–1418.

Nicolini, D. (2011). Practice as the site of knowing: Insights from the field of telemedicine. *Organization Science*, *22*(No. 3 May-June 2015), 602–620.

Nicolson, G. (2020, March). CORONAVIRUS #LOCKDOWN: In a national address, Ramaphosa announces mass screening and testing campaign. Retrieved April 13, 2020, from https://www.dailymaverick.co.za/article/2020-03-30-in-a-national-address-ramaphosa-announces-mass-screening-and-testing-campaign/

Noir, C., & Walsham, G. (2007). The great legitimizer: ICT as myth and ceremony in the Indian healthcare sector. *Information Technology and People*, *20*(4), 313 – 333.

Nurmatov, U. B., Lee, S. H., Nwaru, B. I., Mukherjee, M., Grant, L., & Pagliari, C. (2014). The effectiveness of mHealth interventions for maternal, newborn and child health in low- and middle-income countries: Protocol for a systematic review and meta-analysis. *Journal of Global Health*, *4*(1), 010407.

Obasola, O. I., Mabawonku, I., & Lagunju, I. (2015). A review of e-Health interventions for maternal and child health in Sub-Saharan Africa. *Maternal and Child Health Journal*, *19*(8), 1813–1824.

Okhuysen, G. A., & Bechky, B. A. (2009). Coordination in Organizations: An Integrative Perspective. *Academy of Management Annals*, *3*(1), 463–502.

OpenHIE. (n.d.). Retrieved October 10, 2014, from http://ohie.org/

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research*, *2*(1), 1–28.

Orlikowski, W. J., & Iacono, C. S. (2001). Research Commentary: Desperately Seeking the "IT" in IT Research—A Call to Theorizing the IT Artifact. *Information Systems Research*, *12*(2), 121–134.

Orlikowski, W. J., & Robey, D. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, *3*(3), 398–427.

Orlikowski, W. J., Yates, J., Okamura, K., & Fujimoto, M. (1995). Shaping electronic communication: The metastructuring of technology in the context of use. *Organization Science*, *6*(4), 423–444.

Packard, R. (1996). Book review: Divided sisterhood - A history of nursing in South Africa by Shula Marks. *The Journal of African History*, *37*(2), 324–326.

Packard, R. M. (1987). Tuberculosis and the development of industrial health policies on the Witwatersrand, 1902-1932. *Journal of Southern African Studies*, *13*(2), 187–209.

Paim, J., Travassos, C., Almeida, C., Bahia, L., & MacInko, J. (2011). The Brazilian health system: History, advances, and challenges. *The Lancet*, *377*(9779), 1778–1797.

Palitza, K., Ridgard, N., Struthers, H., & Harber, A. (Eds.). (2010). *What is Left Unsaid: Reporting the South African HIV Epidemic*. Johannesburg: Fanele.

Parmigiani, A., & Howard-Grenville, J. (2011). Routines revisited: Exploring the capabilities and practice perspectives. *The Academy of Management Annals*, *5*(1), 413–453.

Pentland, B. T., & Feldman, M. S. (2008). Designing routines: On the folly of designing artifacts, while hoping for patterns of action. *Information and Organization*, *18*(4), 235–250.

Perry, H., & Crigler, L. (2014). *Developing and Strengthening Community Health Worker Programs at Scale: A Reference Guide and Case Studies for Program Managers and Policymakers*.

Perry, H., Zulliger, R., Scott, K., Javadi, D., Gergen, J., Shelley, K., … Strodel, R. (2017). *Case Studies of Large-Scale Community Health Worker Programs: Examples from Afghanistan, Bangladesh, Brazil,Ethiopia, Niger, India, Indonesia, Iran, Nepal,Pakistan, Rwanda, Zambia, and Zimbabwe*.

Pimmer, C., & Tulenko, K. (2015). The convergence of mobile and social media: Affordances and constraints of mobile networked communication for health workers in low- and middle-income countries. *Mobile Media & Communication*, 1–18.

Pine, K. H., & Mazmanian, M. (2017). Artful and contorted coordinating: The ramifications of imposing formal logics of task jurisdiction on situated practice. *Academy of Management Journal*, *60*(2), 720–742.

Pipek, V., & Wulf, V. (2009). Infrastructuring: Toward an Integrated Perspective on the Design and Use of Information Technology. *Journal of the Association for Information Systems*, *10*(May 2009), 447–473.

Prata, N., Passano, P., Sreenivas, A., & Gerdts, C. E. (2010). Maternal mortality in developing countries: Challenges in scaling-up priority interventions. *Women's Health*, *6*(2), 311–327.

Prgomet, M., Georgiou, A., & Westbrook, J. I. (2009). The impact of mobile handheld technology on hospital physicians' work practices and patient care: A systematic review. *Journal of the American Medical Informatics Association*, *16*(6), 792–801.

Pullon, S., Morgan, S., Macdonald, L., McKinlay, E., & Gray, B. (2016). Observation of interprofessional collaboration in primary care practice: A multiple case study. *Journal of Interprofessional Care*, *30*(6), 787–794.

Purkayastha, S., Manda, T. D., & Sanner, T. A. (2013). A post-development perspective on mHealth - An implementation initiative in Malawi. In *Proceedings of the Annual Hawaii International Conference on System Sciences* (pp. 4217–4225). IEEE Comput. Soc.

Randell, R., Wilson, S., & Woodward, P. (2011). The importance of the verbal shift handover report: A multi-site case study. *International Journal of Medical Informatics*, *80*(11), 803–12.

Rapley, M., & Antaki, C. (1998). "What do you think about...?": Generating views in an interview. *Text - Interdisciplinary Journal for the Study of Discourse*, *18*(4), 587–608.

Rapley, T. J. (2001). The art(fulness) of open-ended interviewing: Some considerations on analysing interviews. *Qualitative Research*, *1*(3), 303–323.

Rasmussen, S. L. (2018). Plans and "off-plan activities": Exploring the roles of data and situated action in health planning in Burkina Faso. *Electronic Journal of Information Systems in Developing Countries*, *84*(5), 1–9.

Reay, T., Golden-Biddle, K., & Germann, K. (2006). Legitimizing a new role: Small wins and microprocesses of change. *Academy of Management Journal*, *49*(5), 977–998.

Reay, T., Goodrick, E., Waldorff, S., & Casebeer, A. (2016). Getting leopards to change their spots: Co-creating a new professional role identity. *Academy of Management Journal*, forthcoming.

Reay, T., Patterson, E. M., Halma, L., & Steed, W. B. (2006). Introducing a nurse practitioner: Experiences in a rural Alberta family practice clinic. *Canadian Journal of Rural Medicine*, *11*(2), 101–107.

Reddy, K. S., Patel, V., Jha, P., Paul, V. K., Kumar, S., & Dandona, L. (2011). Towards achievement of universal health care in India by 2020: A call to action. *The Lancet*, *377*(9767), 760–768.

Reddy, M. C., Dourish, P., & Pratt, W. (2001). Coordinating heterogeneous work: Information and representation in medical care. In *Proceedings of European Conference on Computer Supported Cooperative Work. Bonn, Germany. September 16-20, 2001* (pp. 239–258).

Ribes, D., Jackson, S., Geiger, S., Burton, M., & Finholt, T. (2013). Artifacts that organize: Delegation in the distributed organization. *Information and Organization*, *23*(1), 1–14.

Riemer, K., & Johnston, R. B. (2014). Rethinking the place of the artefact in IS using Heidegger's analysis of equipment. *European Journal of Information Systems*, *23*, 273–288.

RMCH. (2014). MomConnect: Frequently asked questions for healthcare professionals at clinics. Retrieved February 24, 2015, from http://www.rmchsa.org/wp-content/uploads/2014/08/DOHMomConnectFAQs-ClinicsDemonstration-July-2014.pdf

RMCH. (2015, June). About MomConnect.

Rockefeller Foundation. (2010). *From silos to systems: An overview of eHealth's transformative*

power. New York.

Roess, A., Gurman, T., Ghoshal, S., & Mookherji, S. (2014). Reflections on the potential of mHealth to strengthen health systems in low- and middle-Income countries. *Journal of Health Communication*, *19*(January 2015), 871–875.

Romanow, D., Cho, S., & Straub, D. (2012). Riding the wave: Past trends and future directions for Health IT research. *MIS Quarterly*, *36*(3), iii–x.

Romanow, D., Rai, A., & Keil, M. (2018). CPOE-enabled coordination: Appropriation for deep structure use and impacts on patient outcomes. *MIS Quarterly: Management Information Systems*, *42*(1), 189–212.

SABC Digital News. (2014a, August). MomConnect initiative launch. Retrieved October 10, 2014, from http://www.youtube.com/watch?v=dUnf2loC_l4&feature=youtube_gdata_player

SABC Digital News. (2014b, August). MomConnect to link expectant mothers with vital info. Retrieved October 10, 2014, from http://www.youtube.com/watch?v=oXAUR2NOeu0&feature=youtube_gdata_player

Sahay, S., Monteiro, E., & Aanestad, M. (2009). Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India. *Journal of the Association for Information Systems*, *5*(3), 399–414.

Sahay, S., Nielsen, P., & Aanestad, M. (2019). Institutionalizing information systems for universal health coverage in primary healthcare and the need for new forms of institutional work. *Communications of the Association for Information Systems*, *44*, 62–80.

Sahay, S., & Walsham, G. (2006). Scaling of health information systems in India: Challenges and approaches. *Information Technology for Development*, *12*(3), 185–200.

Saldaña, J. (2013). *The Coding Manual for Qualitative Researchers* (Second Edi). Los Angeles: Sage Publications.

Saleem, J. J., Russ, A. L., Neddo, A., Blades, P. T., Doebbeling, B. N., & Foresman, B. H. (2011). Paper persistence, workarounds, and communication breakdowns in computerized consultation management. *International Journal of Medical Informatics*, *80*(7), 466–479.

Salhani, D., & Coulter, I. (2009). The politics of interprofessional working and the struggle for professional autonomy in nursing. *Social Science & Medicine*, *68*(7), 1221–1228.

Sanner, T. A., & Øvrelid, E. (2019). Informating hospital workflow coordination. *Computer Supported Cooperative Work*.

Sarker, S., Chatterjee, S., Xiao, X., & Elbanna, A. (2019). The sociotechnical axis of cohesion for the IS discipline: Its historical legacy and its continued relevance. *MIS Quarterly: Management Information Systems*, *43*(3), 695–719.

Sarker, S., Xiao, X., & Beaulieu, T. (2013). Qualitative Studies in Information Systems: A Critical Review and Some Guiding Principles. *MIS Quarterly*, *37*(4), iii–xviii.

Sarker, S., Xiao, X., Beaulieu, T., & Lee, A. S. (2018). Learning from first-generation qualitative approaches in the is discipline: An evolutionary view and some implications for authors and evaluators (part 1/2). *Journal of the Association for Information Systems*, *19*(8), 752–774.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., … Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality and Quantity*, *52*(4), 1893–1907.

Scheepers, R., Scheepers, H., & Ngwenyama, O. K. (2006). Contextual influences on user satisfaction with mobile computing: Findings from two healthcare organizations. *European Journal of Information Systems*, *15*(3), 1–8.

Schmidt, K., & Bannon, L. (2013). Constructing CSCW: The first quarter century. *Computer Supported Cooperative Work*, *22*(4), 345–372.

Schmidt, K., & Simone, C. (1996). Coordination mechanisms: Towards a conceptual foundation of CSCW systems design. *Computer Supported Cooperative Work*, *5*(2-3), 155–200.

Schneider, H., Daviaud, E., Besada, D., Rohde, S., & Sanders, D. (2018). Ward-based primary health

care outreach teams in South Africa: Developments, challenges and future directions. In L. Rispel & A. Padarath (Eds.), *South African Health Review 2018* (pp. 59–66). Durban, South Africa: Health Systems Trust.

Schneider, H., Hlophe, H., & Van Rensburg, D. (2008). Community health workers and the response to HIV/AIDS in South Africa: Tensions and prospects. *Health Policy and Planning*, *23*(3), 179–187.

Schneider, H., & Lehmann, U. (2016). From community health workers to community health systems: Time to widen the horizon? *Health Systems and Reform*, *2*(2), 112–118.

Seddon, P. B., & Scheepers, R. (2012). Towards the improved treatment of generalization of knowledge claims in IS research: Drawing general conclusions from samples. *European Journal of Information Systems*, *21*(1), 6–21.

Sharma, U., & Clarke, M. (2014). Nurses' and community support workers' experience of telehealth: A longitudinal case study. *BMC Health Services Research*, *14*(1), 164.

Smith, J. M., de Graft-Johnson, J., Zyaee, P., Ricca, J., & Fullerton, J. (2015). Scaling up high-impact interventions: How is it done? *International Journal of Gynecology & Obstetrics*, *130*, S4–S10.

Smith, W. K., & Besharov, M. L. (2019). *Bowing before Dual Gods: How Structured Flexibility Sustains Organizational Hybridity*. *Administrative Science Quarterly* (Vol. 64).

Solarin, I., & Black, V. (2013). "They told me to come back": Women's antenatal care booking experience in inner-city johannesburg. *Maternal and Child Health Journal*, *17*, 359–367.

Sørensen, C., Al-Taitoon, A., Kietzmann, J., Pica, D., Wiredu, G. O., Elaluf-calderwood, S. S., … Gibson, D. (2008). Exploring enterprise mobility: Lessons from the field. *Information Knowledge Systems Management*, *7*, 243–271.

Sørensen, T., Rivett, U., & Fortuin, J. (2008). A review of ICT systems for HIV/AIDS and anti-retroviral treatment management in South Africa. *Journal of Telemedicine and Telecare*, *14*(1), 37–41.

South African Government News Agency. (2014a). MomConnect to link mothers to vital healthcare. Retrieved October 10, 2014, from http://www.sanews.gov.za/south-africa/momconnect-link-mothers-vital-healthcare

South African Government News Agency. (2014b, July). MomConnect to link expectant mums with vital info. Retrieved September 23, 2014, from http://www.sanews.gov.za/south-africa/momconnect-link-expectant-mums-vital-info

Stadler, J., & Dugmore, C. (2017). "Honey, Milk and Bile": A social history of Hillbrow, 1894-2016. *BMC Public Health*, *17*(Suppl 3).

Stadler, J., Scorgie, F., van der Straten, A., & Saethre, E. (2015). Adherence and the lie in a HIV prevention clinical trial. *Medical Anthropology*.

Star, S. L., & Strauss, A. (1999). Layers of silence, arenas of voice: The ecology of visible and invisible work. *Computer Supported Cooperative Work*, *8*(1-2), 9–30.

Stephens, K. K. (2018). *Negotiating Control: Organizations and Mobile Communication*. New York, USA: Oxford University Press.

Stisen, A., & Verdezoto, N. (2017). Clinical and non-clinical handovers: Designing for critical moments. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work* (pp. 2166–2178).

Stisen, A., Verdezoto, N., Blunck, H., Kjærgaard, M. B., & Grønbæk, K. (2016). Accounting for the invisible work of hospital orderlies: Designing for local and global coordination. *Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW*, *27*, 980–992.

Strauss, A., Fagerhaugh, S., Suczek, B., & Wiener, C. (1985). *Social Organization of Medical Work*. Chicago: The University of Chicago Press.

Strauss, A. L., & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. *Handbook of Qualitative Research* (2nd ed.). Thousand Oaks, CA: Sage.

Street, C. T., & Ward, K. W. (2012). Improving validity and reliability in longitudinal case study

timelines. *European Journal of Information Systems*, *21*(2), 160–175.

Strong, D. M., Volkoff, O., Johnson, S. A., Pelletier, L. R., Bar-On, I., Tulu, B., … Garber, L. (2009). A theory of clinic-EHR affordance actualization. In *Proceedings of the JAIS Theory Development Workshop. Sprouts Working Paper on Information Systems. 9 (47)*.

Strong, D., & Volkoff, O. (2010). Understanding Organization-Enterprise System Fit: A Path to Theorizing the Information Technology Artifact. *MIS Quarterly*, *34*(4), 731–756.

Sudnow, D. (1967). *Passing On: The Social Organizationof Dying*. Englewood Cliffs, NJ: Prentice-Hall.

Sunguya, B. F., Hinthong, W., Jimba, M., & Yasuoka, J. (2014). Interprofessional education for whom? - Challenges and lessons learned from its implementation in developed countries and their application to developing countries: A systematic review. *PLoS ONE*, *9*(5).

Svensson, R. (1996). The interplay between doctors and nurses - A negotiated order perspective. *Sociology of Health & Illness*, *18*(3), 379–398.

Sweet, H. (2017). Mission nursing in the South African context: The spread of knowledge during the colonial and apartheid periods. In E. Fleischmann, S. Grypma, M. Marten, & I. M. Okkenhaug (Eds.), *Transnational and Historical Perspectives on Global Health, Welfare and Humanitarianism* (pp. 137–156). Kristiansand: Portal Books.

Sykes, T. A., Venkatesh, V., & Gosain, S. (2015). Model of Acceptance with Peer Support: A Social Network Perspective to Understand Employees' System Use. *MIS Quarterly*, *33*(2), 371–393.

Tabatabai, A. (2019). Where top VCs are investing in digital health. Retrieved March 10, 2020, from https://techcrunch.com/2019/12/16/where-top-vcs-are-investing-in-digital-health/

Takian, A., Petrakaki, D., Cornford, T., Sheikh, A., & Barber, N. (2012). Building a house on shifting sand: Methodological considerations when evaluating the implementation and adoption of national electronic health record systems. *BMC Health Services Research*, *12*(105), 1–11.

Tavory, I., & Timmermans, S. (2009). Two cases of ethnography: Grounded theory and the extended case method. *Ethnography*, *10*(3), 243–263.

Tavory, I., & Timmermans, S. (2014). *Abductive Analysis: Theorizing Qualitative Research*.

Taylor, F. (1916). The principles of scientific management. *Bulletin of the Taylor Sociiety*.

teleSUR. (2017). Central Trade Unions in India Led Nationwide Strike Against Govts Austerity Measures. Retrieved January 20, 2017, from https://www.telesurtv.net/english/amp/english/news/Central-Trade-Unions-in-India-Led-Nationwide-Strike-Against--Govts-Austerity-Measures-20180117-0020.html?__twitter_impression=true

The Hindu. Karnataka Bureau. (2018). Anganwadi, ASHA workers stage protest to press for demands. Retrieved February 2, 2018, from http://www.thehindu.com/news/national/karnataka/anganwadi-asha-workers-stage-protest-to-press-for-demands/article22459119.ece

The Homelands. (2011, April). Retrieved May 16, 2018, from http://www.sahistory.org.za/article/homelands

Tilson, D. A., Lyytinen, K., & Sorensen, C. (2010). Digital infrastructures: The missing IS research agenda. *Information Systems Research*, *21*(4), 748–759.

Timmermans, S. (1998). Social death as self-fulfilling prophecy: David Sudnow's "Passing On" revisited. *The Sociological Quarterly*, *39*(3), 453–472.

Timmermans, S., & Berg, M. (1997). Standardization in action: Achieving local universality through medical protocols. *Social Studies of Science*, *27*(2), 273–305.

Timmermans, S., & Tavory, I. (2012). Theory construction in qualitative research: From grounded theory to abductive analysis. *Sociological Theory*, *30*(3), 167–186.

Tomasi, E., Facchini, L. A., & Maia, M. D. F. S. (2004). Health Information Technology in primary health care in developing countries: A literature review. *Bulletin of the World Health Organization*, *82*(11), 867–74.

Tomlinson, M., Rotheram-Borus, M. J., Swartz, L., & Tsai, A. C. (2013). Scaling Up mHealth: Where is

the evidence? *PLoS Medicine*, *10*(2), 1–5.

Unstructured Supplementary Service Data - Wikipedia, the free encyclopedia. (n.d.). Retrieved May 17, 2015, from http://en.wikipedia.org/wiki/Unstructured_Supplementary_Service_Data

Urquhart, C., & Fernández, W. (2016). Using grounded theory method in information systems: The researcher as blank slate and other myths. In *Enacting Research Methods in Information Systems: Volume 1* (pp. 129–156).

Valentine, M. A., & Edmonson, A. C. (2014). Team scaffolds: How mesolevel structures enable role-based coordination in temporary groups. *Organization Science*, *26*(2), 405–422.

van Ginneken, N., Lewin, S., & Berridge, V. (2010). The emergence of community health worker programmes in the late apartheid era in South Africa: An historical analysis. *Social Science & Medicine*, *71*(6), 1110–1118.

van Offenbeek, M., Boonstra, A., & Seo, D. (2013). Towards integrating acceptance and resistance research: Evidence from a telecare case study. *European Journal of Information Systems*, *22*(4), 434–454.

van Wieringen, M., Groenewegen, P., & Broese van Groenou, M. I. (2017). "We"re all Florence Nightingales': Managers and nurses colluding in decoupling through contingent roles. *Journal of Professions and Organization*, *46*, 202–28.

van Zyl, I., & de la Harpe, R. (2014). Mobile application design for health intermediaries: Considerations for information access and use. In *Proceedings of the International Conference on Health Informatics* (pp. 323–328).

Varkey, S. J. (2000). Abortion services in South Africa: Available yet not accessible to all. *International Family Planning Perspectives*, *26*(2), 87.

Varshney, U. (2014). Mobile health: Four emerging themes of research. *Decision Support Systems*, *66*, 20–35.

Varshney, U., & Mayora, O. (2007). Special issue on pervasive healthcare. *Mobile Networks and Applications*, *12*(2-3), 111–112.

Venkatesh, V., Sykes, T. A., & Zhang, X. (2011). "Just what the doctor ordered": A revised UTAUT for EMR system adoption and use by doctors. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 1–10.

Victora, C. G., Barreto, M. L., Do Carmo Leal, M., Monteiro, C. a., Schmidt, M. I., Paim, J., … Barros, F. C. (2011). Health conditions and health-policy innovations in Brazil: The way forward. *The Lancet*, *377*(9782), 2042–2053.

Vital Wave Consulting. (2009). *mHealth for development: The opportunity of mobile technology for healthcare in the developing world*. Washington, D.C. and Berkshire, UK.

Vygotsky, L. (1978). *Mind in Society: The Development of Higher Psychological Processes*. (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.) (New Ed). Harvard University Press.

Walker, L., & Gilson, L. (2004). "We are bitter but we are satisfied": Nurses as street-level bureaucrats in South Africa. *Social Science & Medicine*, *59*(6), 1251–1261.

Walsham, G. (1995). Interpretive case studies in IS research: Nature and method. *European Journal of Information Systems*, *4*(1973), 74–81.

Walsham, G. (1997). Actor-Network Theory and IS research: Current status and future prospects. In A. S. Lee, J. Liebenau, & J. I. DeGross (Eds.), *Information Systems and Qualitative Research* (Vol. 466, pp. 466–480). Chapman and Hall.

Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems*, *15*(3), 320–330.

Waring, J. J., & Bishop, S. (2010). Lean healthcare: Rhetoric, ritual and resistance. *Social Science & Medicine*, *71*(7), 1332–1340.

Wears, R., & Berg, M. (2005). Computer technology and clinical work: Still waiting for Godot. *JAMA: The Journal of the American Medical Association*, *293*(10), 1261–1263.

Weeger, A., & Gewald, H. (2015). Acceptance and use of Electronic Medical Records: An exploratory

study of hospital physicians' salient beliefs about HIT systems. *Health Systems*, *4*(May), 64–81.

Weiss, R. S. (1995). *Learning From Strangers: The Art and Method of Qualitative Interview Studies* (First Edit). New York: The Free Press.

Wiesche, M., Jurisch, M. C., Yetton, P. W., & Krcmar, H. (2017). Grounded theory methodology in information systems research. *MIS Quarterly: Management Information Systems*, *41*(3), 685–701.

Wikipedia. (2020, April). History of Cape Town. In *Wikipedia*.

Williams, F., & Boren, S. A. (2008). The role of the electronic medical record (EMR) in care delivery development in developing countries: A systematic review. *Informatics in Primary Care*, *16*(2), 139–45.

Wiredu, G. O. (2007). User appropriation of mobile technologies: Motives, conditions and design properties. *Information and Organization*, *17*(2), 110–129.

Wiredu, G. O., & Sørensen, C. (2006). The dynamics of control and mobile computing in distributed activities. *European Journal of Information Systems*, *15*, 307–319.

Wolff-Piggott, B., Coleman, J., & Rivett, U. (2017). The clinic-level perspective on mHealth implementation: A South African case study. *Information Technology for Development*.

Wood, R., Kaplan, R., Bekker, L. G., Brown, S., & Rivett, U. (2008). The utility of pharmacy dispensing data for ART programme evaluation and early identification of patient loss to follow-up. *Southern African Journal of HIV Medicine*, *9*(2), 44.

World Health Organization. (2011). mHealth: New horizons for health through mobile technologies. Global Observatory for eHealth series - Volume 3, *3*, 112.

World Health Organization and International Telecommunication Union. (2012). *National eHealth Strategy Toolkit*. Geneva.

Wu, I., Li, J., & Fu, C. (2011). The adoption of mobile healthcare by hospital's professionals: An integrative perspective. *Decision Support Systems*, *51*(3), 587–596.

Xiong, K., Kamunyori, J., & Sebidi, J. (2018). The MomConnect helpdesk: How an interactive mobile messaging programme is used by mothers in South Africa. *BMJ Global Health*, *3*, 1–7.

Yin, R. K. (2002). *Case Study Research: Design and Methods, Third Edition, Applied Social Research Methods Series, Vol 5* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Yuan, Y., Archer, N., Connelly, C. E., & Zheng, W. (2010). Identifying the ideal fit between mobile work and mobile work support. *Information & Management*, *47*(3), 125–137.

Zachariah, R., Ford, N., Philips, M., S.Lynch, Massaquoi, M., Janssens, V., & Harries, D. (2009). Task shifting in HIV/AIDS: Opportunities, challenges and proposed actions for sub-Saharan Africa. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *103*(6), 549–558.

Appendix A Health Facility Descriptions (National Department of Health: Republic of South Africa, 2015a)

Type	Description
Clinic	
Summary	This health facility normally functions only on weekdays during working hours. Antenatal care is one of a number of activities in the clinic, the others being chronic diseases, child health, family planning, etc.
Functions	• Antenatal care for low and intermediate risk women, including point of care blood and urine testing. • Postnatal follow-up visits, including the provision of contraceptive services. • Referral of patients identified with risk factors for pregnancy complications to appropriate health facilities (according to referral patterns). • The immediate management of obstetric and neonatal emergencies.
Staffing	Professional nurses, enrolled nurses, nursing assistants, community health workers and a visiting medical officer.
Facilities	• All the necessities to run an antenatal clinic. • Equipment and drugs for obstetric emergencies (oxygen, ringer's lactate solution, magnesium sulphate, salbutamol). • Sterile delivery packs for unscheduled deliveries. • Reliable transport service for emergency transfer to an appropriate facility. • An effective communication system (radio or telephone). • Contraceptive Services including insertion of IUCD's and Implants.

Community Health Centre	
Summary	This is a 24-hour comprehensive health service with an obstetric unit run by midwives. Where it stands alone as a maternity service, it might be called a midwife obstetric unit (MOU). More often, the maternity section will run alongside other services such as emergency care, minor ailments, chronic diseases, and promotive services.
Functions	• Low- to intermediate-risk antenatal care. • Basic emergency obstetric care signal functions: magnesium sulphate, intravenous antibiotics, oxytocics, vacuum delivery, removal of retained placenta, manual vacuum aspiration, neonatal resuscitation. • 24-hour labour and delivery service for low risk women. • Comprehensive contraceptive care. • Referral of problems to hospital. • Management of emergencies.
Staffing	Advanced midwives, midwives, enrolled nurses, nursing assistants, community health workers, visiting or resident dietician and a visiting or resident medical officer.
Facilities	• All the necessities to run an antenatal clinic. • All equipment to run a low risk labour ward. • Hand-held Doppler instrument for fetal heart auscultation. • An effective communication system (radio or telephone). • Reliable 24-hour transport service for emergency transfer to hospital.

District Hospital	
Summary	The package of services provided at district hospitals includes trauma and emergency care, in -patient and outpatient visits; paediatric and obstetric care. These hospitals may employ specialist family physicians, obstetrician/gynaecologists and paediatricians.
Functions	• Antenatal care for high-risk women. • Antenatal ultrasound service. • Treatment of pregnancy problems, including admission to hospital. • Comprehensive emergency obstetric care signal functions: magnesium sulphate, intravenous antibiotics, oxytocics, vacuum delivery, removal of retained placenta, manual vacuum aspiration, neonatal resuscitation, caesarean section and blood transfusion. • 24-hour labour and delivery service including caesarean sections. • Regional and general anaesthesia. • Essential special investigations. • Postnatal care and postoperative care. • Contraceptive services including postpartum and elective tubal ligation. • Referral centre for clinics and community health centres in the district. • Supervision of clinics and community health centres in the district. • Referral of complicated problems to regional or tertiary hospitals. • Counselling and support services. • Genetic screening and counselling services.
Staffing	Advanced midwives, midwives, enrolled nurses, nursing assistants, social workers,

	dietician, full time medical officers and visiting specialist obstetricians.
Facilities	• All the necessities to run an antenatal clinic including an ultrasound scanner. • All equipment to run a high-risk labour ward including a vacuum extractor, cardiotocograph (CTG) machines, pulse oximeters and intravenous fluid infusion pumps. • A 24 hour laboratory service. • Anthropometric equipment • Emergency blood. • Equipment and drugs for obstetric emergencies including a fully equipped resuscitation trolley and defibrillator. • Fully equipped operating theatre. • X-ray facilities. • Reliable transport service for emergency transfer to regional or tertiary hospitals. • A mothers' waiting area in rural areas with poor transport infrastructure.

Appendix B Interview Guiding Questions and Observation Protocol

B1. Guiding Topics

Facility Manager Initial Interviews

Guiding Questions for Initial Interviews	Purpose
Confirm name, experience as a facility manager (years), time at this clinic as facility manager	Obtain background information and their perceptions of the clinic. Establish connection.
General Description of the Clinic	
No of patients seen per month	
Characterisation of numbers of people in the "catchment", socioeconomic profile, other characteristics	
No of ANC nurses, health intermediaries and general support staff	
Biggest issues facing the clinic	Identify their key concerns at the clinic
MAMA vs MomConnect	Explore their perceptions of MAMA vs MomConnect especially around dedicated staffing
How is MomConnect registration going?	Explore their perceptions / self-presentation around MomConnect
How is MomConnect registration being carried out?	Identify involved nurses and health intermediaries and their role in registration
Are they receiving feedback on number of registrations and their registrations vs other clinics	Identify to what extent they are involved in client-management communications. Explore their perceptions towards and experience of this process.
Are they receiving feedback from the info line?	
Are they receiving feedback from the compliments / complaints line?	

ANC Nurse and Health Intermediary Initial Interviews

Guiding Questions for Initial Interviews	Purpose
Confirm name, position, experience as a clinic staff member (years), time at this clinic in that position. Previously?	Obtain background information and their perceptions of the clinic. Establish connection.
ANC Section: Nurse / Health Intermediaries	
No of patients seen per week / month (nurse)	Obtain background information. Explore concerns that emerge.
No of people in the "catchment" (**qual**), type of people (resident, working nearby, migrants – language issues)	
Client stage of pregnancy at presentation (nurse)	
Health intermediaries working with them? (nurse)	
Biggest problem in providing antenatal care?	
Familiar with MAMA project? What was their perception of the WRHI fieldworkers that did the MAMA registration? What did they do? (Did they do other tasks as well as registration?)	Explore MomConnect versus MAMA
What is their general sense of MAMA vs MomConnect	
Specific MomConnect Questions	
When did you hear about MomConnect?	Specific information on MomConnect registration and background on their attitudes towards and perceptions of the process.
Received training? By who?	
How well does MomConnect work at the clinic?	
What benefits do you see from MomConnect registration?	
What proportion agree to be registered?	
How do you do the registration now?	
How do you record the mother's information and whether they are registered?	
What is the biggest problem you have in registering women?	
How easily were they solved?	
Are you receiving feedback on number of registrations and their registrations vs other clinics	
Are you receiving feedback from the info line?	
Are you receiving feedback from the compliments / complaints line?	

B2. Registration Observation Protocol

Clinic Name:

Date:

Time Observation Began:

Time Ended:

1. Registering Staff

Name	Designation	Comment

Which staff are responsible for the registration process? What position(s) do they hold? Are they the same as the last time? If not, how do they describe the change?

2. Client Interaction

Stage	Description		Devices	Comment
	Staff	Clients		
Prior				
Engagement				
Information Collection / Registration				
Closure				

How do staff gain attention and break the ice? What is the format of their interaction with the clients (presentation / dialogue etc)? What is the content that the staff provide? How do they try to persuade clients to follow their advice?

How much do clients fidget, move around? How do they dress, how do they interact with each other, physically place themselves in the setting?

How are client details recorded? Is it directly into handsets or in a separate book? Is later interaction required with other staff to complete the registration process?

Where do the clients go at the end of the session?

3. Details of Registration Process

Stage	Problems Encountered	Staff / Client Description

What problems are identified by the staff? What problems are identified by the clients? How do they respond to them? How do they describe them? How serious do they think these problems are?

How will these problems be resolved? What attitudes do the staff express (actively or tacitly) to this?

Are there possibly problems that are not being identified verbally (eg clients quietly consulting each other) during the session?

4. Post-Observation Discussions

What problems and / or issues are identified by the staff after the registration session? When would they be prepared for me to schedule another registration session?

Are there other people involved in registration that I should also speak to?

B3. GENERAL OBSERVATION PROTOCOL

Clinic Name:

Date:

Time Observation Began:

Time Ended:

1. Clinic Overview

Describe the site and setting. Where is the clinic situated? Is it in a residential or business district? Is it close to public transport? Is it close to shops where clients can buy food or other necessities for themselves or children?

Is the clinic attractive (freshly painted, good lighting etc)? How adequate are the waiting area(s)? What is the condition, appropriateness, and quantity of furniture and other equipment? Are there any unmet maintenance needs?

How numerous and prominent are posters, pamphlets and other materials for clients? Attractiveness / suitability for children?

Are there specific spaces for communications to the staff? What kinds of materials are posted there?

2. Clinic Layout

Describe the approximate size of the space (number of rooms), arrangement of furniture, distinguishing features.

Note the color, size, shape, number seats and other furniture and equipment in the space. Note the temperature, noise level. Note any changes in setting as the observation proceeds.

Availability of enough consultation rooms.

Draw up a rough schematic of the clinic layout including seating.

3. Commencement of the Day

Note how the day begins. Who is present first? What is done at the beginning of the day by staff and clients? How does it change?

How long are the morning queues? How do the staff manage the queues? How is paperwork processed?

How much do clients fidget, move around? How do they dress, how do they interact with each other, physically place themselves in the setting?

4. Chronology of Activity and Events (15 minute intervals).

Time	Activity	Key Events
0800		
0815		
0830		
0845		
0900		
0915		
0930		
0945		
1000		
1015		
1030		
1045		
1100		
1115		
1130		
1145		
1200		
1215		
1230		
1245		
1300		
1315		
1330		
1345		
1400		
1415		
1430		
1445		
1500		
1515		
1530		
1545		
1600		

5. Key Activities and Interactions

Type	Description	Examples
Who is interacting?		
How are they interacting?		
Do interactions change over time?		

How do nurses and other staff interact? How do staff and clients interact? Are there unusual interactions that take place? Is it clear why they are different?

Are occasional activities taking place (visits by health managers, other researchers, deliveries of medication)?

Are there any crises (eg arrival of clients with injuries needing immediate attention)? Do the staff need to cover for each other? Are there equipment or infrastructure breakdowns?

6. Description of Nonverbal Communication

How do staff and clients get attention? How much do they fidget, move around? How do they dress, express affection, physically place themselves in the setting?

How do they relate to each other?

7. Closure of the Day

When do the client queues clear? Do the staff start different activities? How do these activities relate to each other?

What are the signals that the day is ending? Who is present, what is said, how do staff and clients react?

Appendix C Descriptive Codes and Families

Code Families

Code Family: 0-WhoUses
Created: 2015-03-27 08:22:47 (Super)
Codes (6): [Champion] [MomConnectNotProfessionalWork] [MomConnectNotUseful] [MomConnectUseful] [MomConnectWhoBenefits] [MomConnectWorkFlow]

Code Family: 1-Contextual
Created: 2015-03-23 14:49:29 (Super)
Codes (44): [ClientChronicConditions] [ClientSubterfuge] [ConvincingMothers] [ElectricityAvailability] [EPWPs] [Financial] [Foreigners] [HandsetNumbersNoLongerContactable] [HandsetUseConcerns] [HIVAIDSDisclosure] [HIVAIDSStigma] [HospitalReferralRelationship] [IdentificationIssues] [LanguageBarriers] [Loadshedding] [Misdiagnosis] [MomConnect] [MomConnectConstraints] [MomConnectHandset] [MomConnectProblematic] [MomConnectTraining] [MomConnectUseful] [MomConnectWhoBenefits] [MothersPregnancySocialPressure] [Overburdened] [Overtime] [PaperWorkflow] [ProtectingTheChild] [Province] [ResourceConstraints] [StaffANCNurseShortage] [StaffANCNurseStaffing] [StaffANCNurseWorkflow] [StaffCoordinationBetweenDisciplines] [Staffing] [StaffMotivation] [StaffRotation] [StaffShortage] [StaffTrainingANCReqmt] [StaffWorkingTogether] [STIs] [TimeConstraint] [Workflow]

Code Family: 2-ClinicPractice
Created: 2015-03-25 09:25:34 (Super)
Codes (32): [ClientChronicConditions] [ClientMultipleConditions] [CommunityHealthWorker] [CondomUse] [FacilityReferral] [FacilityTracers] [FlexibleRoles] [HealthPromoters] [HIVAIDS] [HIVAIDSAdherence] [HIVAIDSCounselling] [HIVAIDSDisclosure] [HIVAIDSInitiation] [HIVAIDSInitiationThresholds] [HIVAIDSStaging] [HIVAIDSStigma] [HospitalReferralRelationship] [IncreasingBurdenOfWork] [MothersPregnancyRisks] [Outreach] [PHCReengineering] [StaffANCCommunity] [StaffANCNurseWorkflow] [StaffRotation] [STIs] [TechFtrRegistration] [UnderlyingConditions] [Workflow] [WorkPractice] [WorkPracticeCommunity] [WorkPracticeCommunityOutreach] [WorkProcess]

Code Family: 3-Contradictions
Created: 2015-03-25 09:25:52 (Super)
Codes (1): [MomConnectWhoBenefits]

Code Family: 4-Breakdowns
Created: 2015-03-25 09:26:16 (Super)
Codes (21): [Breakdowns] [ClientSubterfuge] [CondomUse] [Defaulting] [ElectricityAvailability] [Emergencies] [FacilityTracers] [Financial] [HandsetNumbersNoLongerContactable] [HIVAIDSDisclosure] [HIVAIDSStigma] [LateConsultation] [Misdiagnosis] [MomConnectProblematic] [MothersBehaviourProblematic] [MothersDislikeClinic] [MothersPregnancyStageDiagnosis] [OwnRegnTakesTooLong] [StaffCoveringForEachOther] [StaffMotivation] [StaffNursesScapegoated]

Code Family: 5-MomConnect
Created: 2015-03-23 14:29:03 (Super)
Codes (38): [Champion] [ClientConcerns] [ClientCostConcerns] [ClientLazy] [Confidentiality] [DocumentationIssues] [FuncAffrdTimeOut] [HandsetNumbersNoLongerContactable] [HandsetsProblematic] [HandsetUseConcerns] [IdentificationIssues] [MAMA] [MAMAvsMomConnect] [MomConnect] [MomConnectCommunity] [MomConnectConstraints] [MomConnectErrors] [MomConnectFeedback] [MomConnectHandset] [MomConnectHelpLine] [MomConnectHelpLineFeedback] [MomConnectLanguages] [MomConnectMessaging] [MomConnectNotProfessionalWork] [MomConnectNotUseful] [MomConnectPaperRecord] [MomConnectPostPartum] [MomConnectProblematic] [MomConnectTimeConsuming] [MomConnectTraining] [MomConnectUseful] [MomConnectWhoBenefits] [NetworkCoverage] [NotWantingToUseOwnPhone] [OwnRegnTakesTooLong] [RegistrationProblem] [Satisfaction] [TechFtrRegistration]

Code Family: ClientPersuasion
Created: 2015-03-25 11:04:14 (Super)
Codes (3): [ConvincingMothers] [CulturalChallenges] [ProtectingTheChild]
_____

Code Family: FacilityCharacterisation
Created: 2015-03-25 15:51:57 (Super)
Codes (30): [ANC-Attendance] [ClientReasonsForAttending] [ClinicClosure] [ClinicHours] [ClinicStaffing] [EPWPs] [Facility] [FacilityClientNumbers] [FacilityGoals] [FacilityPharmacy] [FacilityResourceAllocation] [FacilityServices] [MothersPregnancyStageDiagnosis] [MothersPrivateMedicalDiagnosis] [PopulationDensity] [Province] [Remuneration] [StaffAdditions] [StaffANCNurseExperience] [StaffANCNurseStaffing] [StaffAttitudes] [StaffCHWCommunity] [StaffCoordinationBetweenDisciplines] [StaffFormalTraining] [Staffing] [StaffLengthService] [StaffNonNurseMobility] [StaffTrainingANCReqmt] [StaffWorkNorms] [TradeOff]
_____

Code Family: Foreigners
Created: 2015-03-25 15:56:58 (Super)
Codes (4): [DocumentationIssues] [Foreigners] [ForeignersNumbers] [LanguageBarriers]
_____

Code Family: OutsideResources
Created: 2015-03-25 16:30:24 (Super)
Codes (2): [HelpfulResearch] [MomConnectResearchReporting]
_____

Code Family: Partners
Created: 2015-03-25 15:58:59 (Super)
Codes (2): [BarriersPartnerInvolvement] [ImportancePartnerInvolvement]
_____

Code Family: ProfessionalIdentity
Created: 2015-03-25 09:29:26 (Super)
Codes (3): [MomConnectNotProfessionalWork] [StaffNursesScapegoated] [TaskShifting]
_____

Code Family: ReportingProcesses
Created: 2015-03-25 15:51:10 (Super)
Codes (5): [MomConnectPaperRecord] [OtherInfSys] [PaperWorkflow] [ReportingDataCapturers] [ReportingHierarchy]
_____

Code Family: ResourceAllocation
Created: 2015-03-25 11:06:50 (Super)
Codes (4): [EPWPs] [FacilityResourceAllocation] [FacilityTracers] [TradeOff]
_____

Code Family: ResourceConstraints
Created: 2015-03-25 15:53:54 (Super)
Codes (13): [Backlog] [ClinicClosure] [Financial] [Infrastructure] [LanguageBarriers] [Loadshedding] [Overburdened] [Overtime] [ResourceConstraints] [StaffANCNurseShortage] [StaffShortage] [StaffWorkStress] [TimeConstraint]
_____

Code Family: Transitions
Created: 2015-03-25 16:00:09 (Super)
Codes (4): [ChangedWork] [MomConnectCommunity] [PHCReengineering] [StaffMovingInFromNGOs]
_____

Code Family: WorkCoordination
Created: 2015-03-25 11:05:34 (Super)
Codes (10): [HospitalReferralRelationship] [InterFacilityMeetings] [StaffANCCommunity] [StaffCHWCommunity] [StaffCoordinationBetweenDisciplines] [StaffCoveringForEachOther] [StaffNonNurseMobility] [StaffWorkingTogether] [TaskShifting] [WorkPracticeCommunity]

Appendix D MomConnect Presentation by WRHI

momconnect

Creating demand for, and improving supply of, maternal health services at National Scale in South Africa.

Multi-language. Integrated. Demand generating. Supply supporting. Maternal Health Programme

health

Department:
Health
REPUBLIC OF SOUTH AFRICA

Technical

jembi health systems NPC

PRAEKELT FOUNDATION

HISP

Facility Implementation

Right to care
TREATING AIDS SERIOUSLY

FPD

BroadReach healthcare

RHI
WITS REPRODUCTIVE HEALTH & HIV INSTITUTE

HEALTH SYSTEMS TRUST

MNOs and Donors

vodacom

CELL C

Telkom

MTN

the ELMA philanthropies

J&J

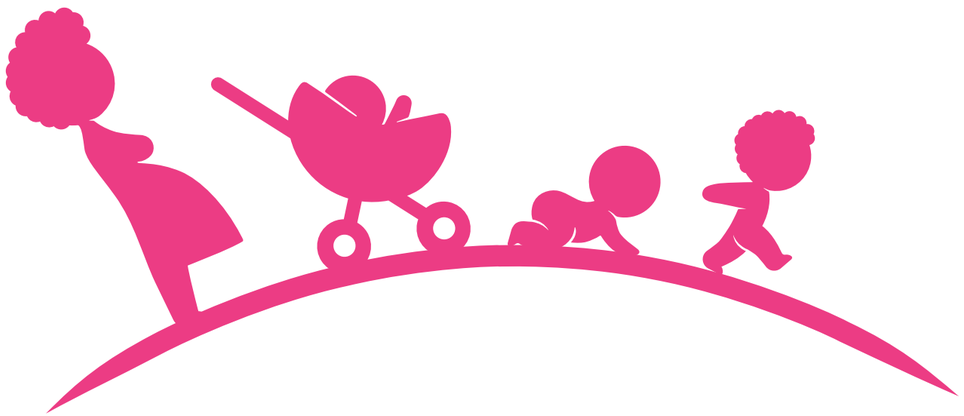
PEPFAR
U.S. President's Emergency Plan for AIDS Relief

CHWs, Nurses and Moms

M&E Partners

UNIVERSITY of the WESTERN CAPE

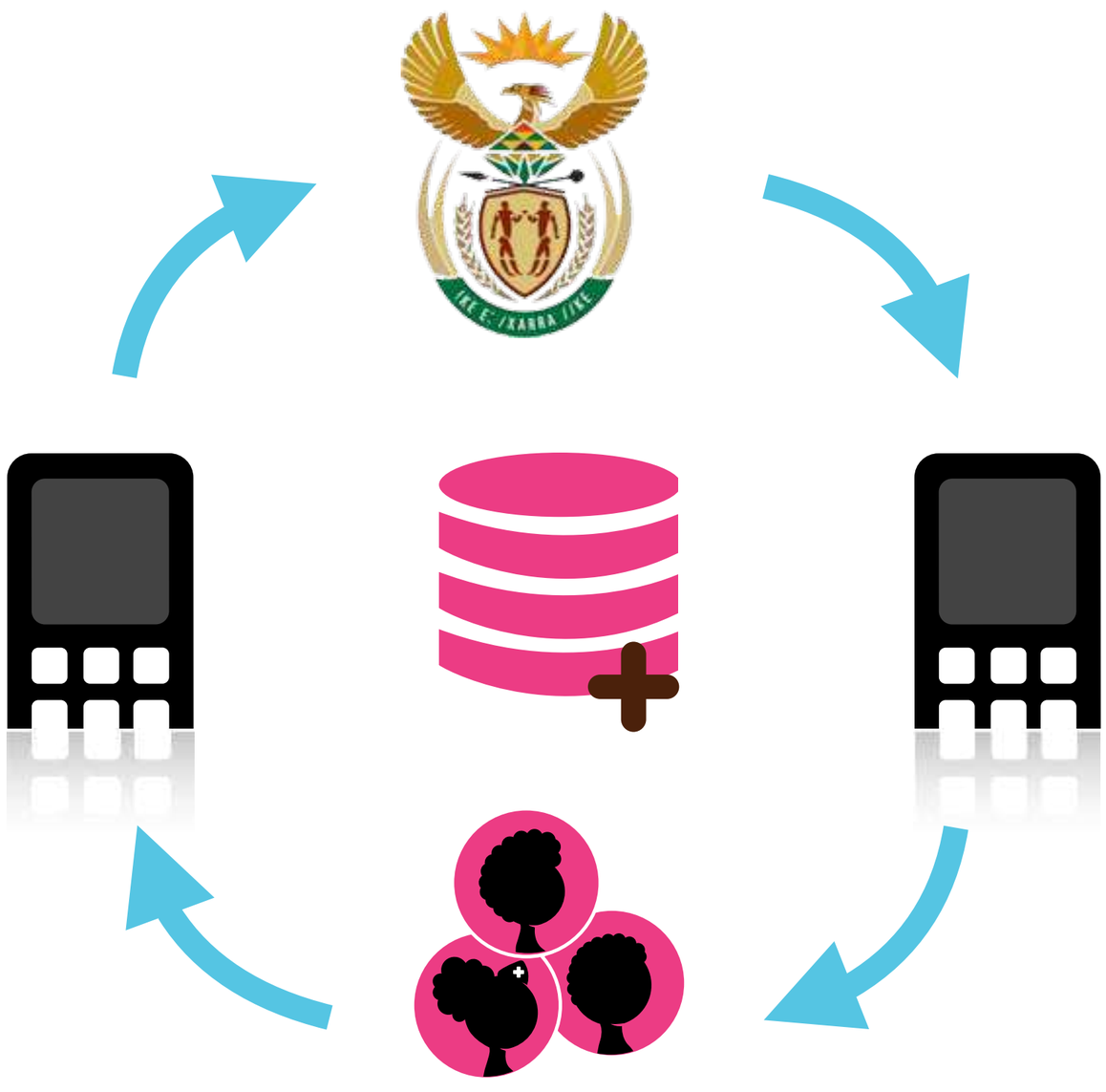
UNIVERSITEIT STELLENBOSCH UNIVERSITY



momconnect

- Central Pregnancy Registry
- SMS Helpdesk
- Stage based Push SMS
- USSD FAQ
- USSD Service Rating

Supply



Demand

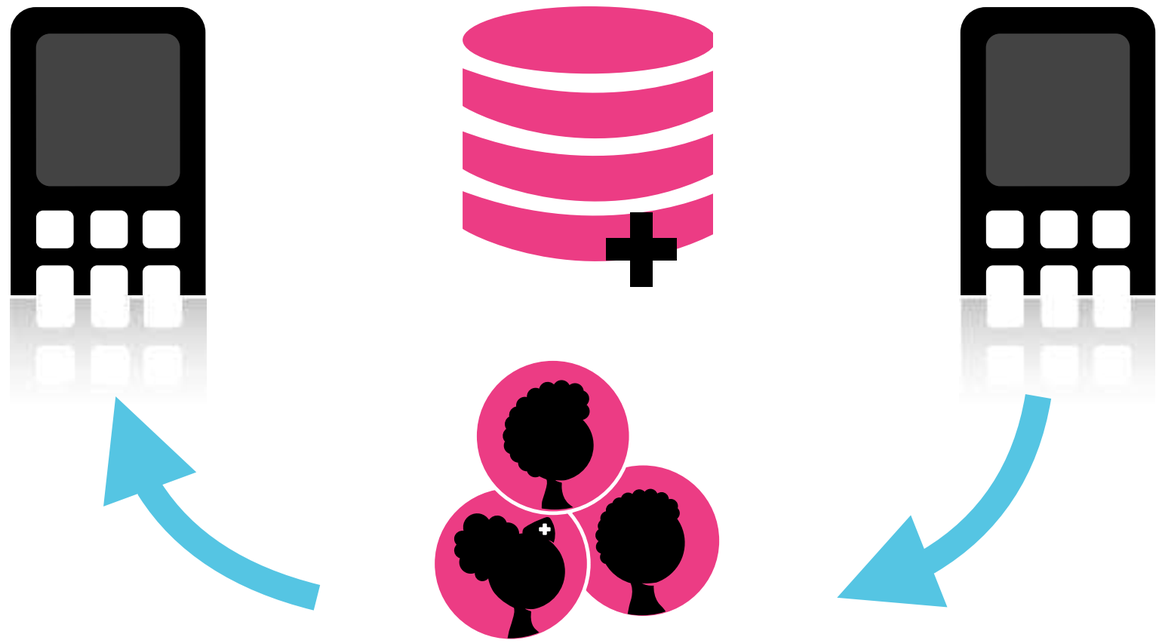
health

Department:
Health
REPUBLIC OF SOUTH AFRICA

Supply

Rating of the service received as well as the ability to log complaints and send compliments puts the power every woman's hand to demand the service she deserves

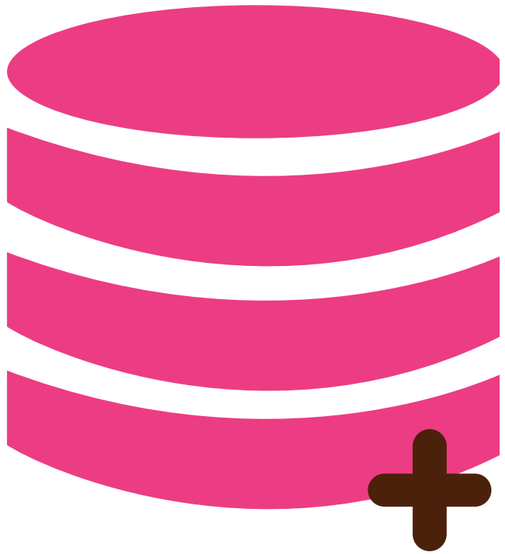
Unique clinic code links supply reporting to clinic



Demand

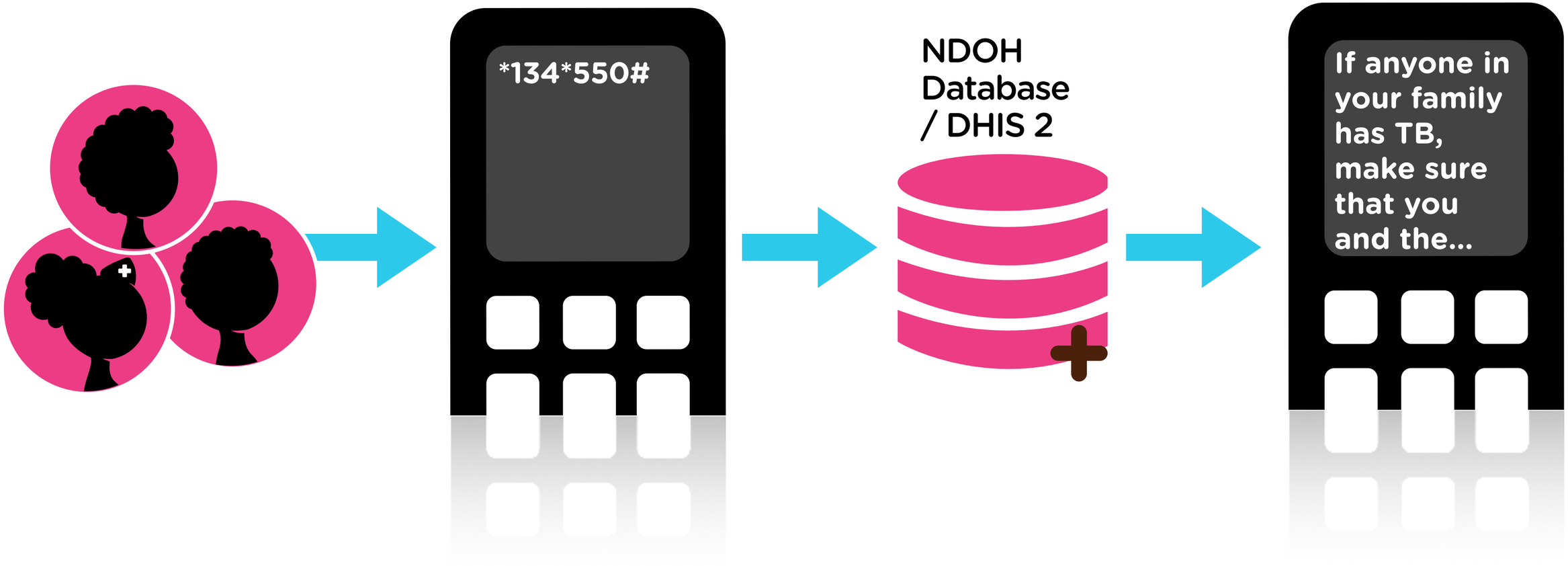
Stage based messaging and and FAQs create demand through increasing knowledge and encouraging health seeking behaviour

National Pregnancy Registry



National ID Number/ Passport Number

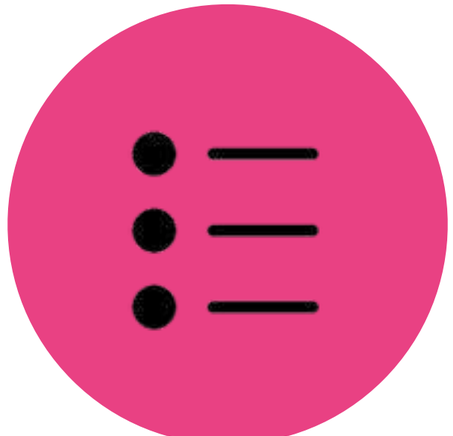
Unique Clinic Code


*134*550#
NDOH
Database
/ DHIS 2
If anyone in your family has TB, make sure that you and the...

Why USSD?

Familiarity

Most South Africans use USSD regularly to top up airtime or send a Please Call Me.



Multiple Options

USSD allows the user to choose and navigate from a menu of options.

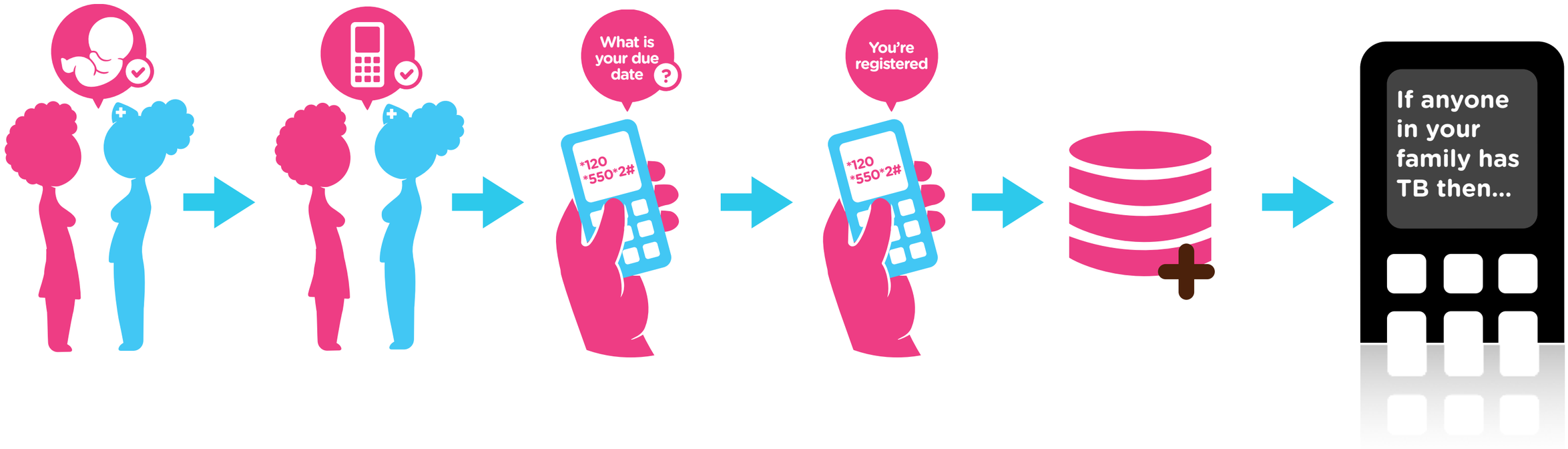
Any phone can access

USSD works on every phone, from the most basic to the most advanced. If you can get a call or send an SMS, you can use USSD.

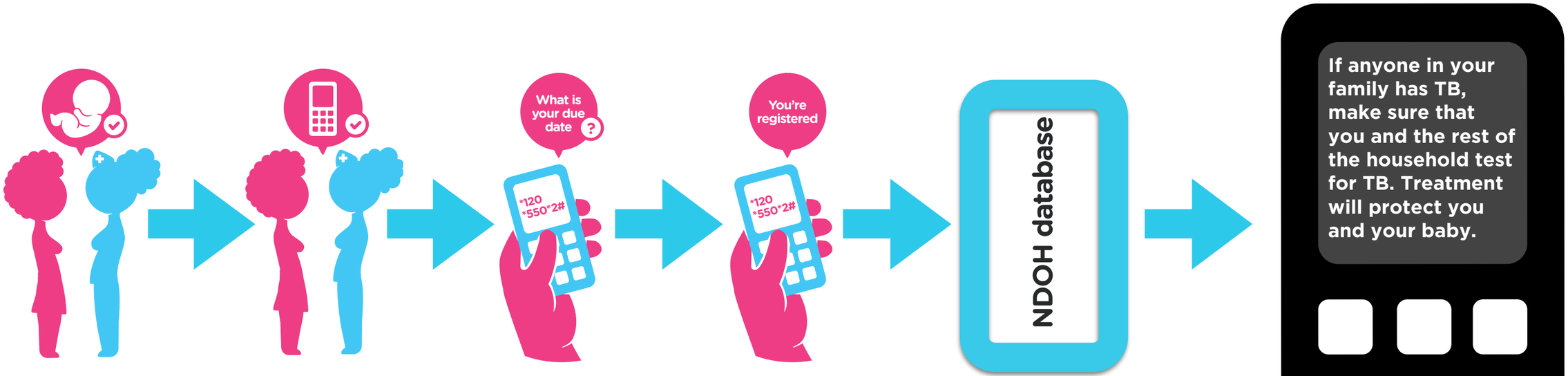
No airtime needed

Negotiations with the Mobile Network Operators means the service will be free for the user. A user can access with no airtime.

How does it work?



How does it work?



1. Nurse confirms pregnancy at clinic.

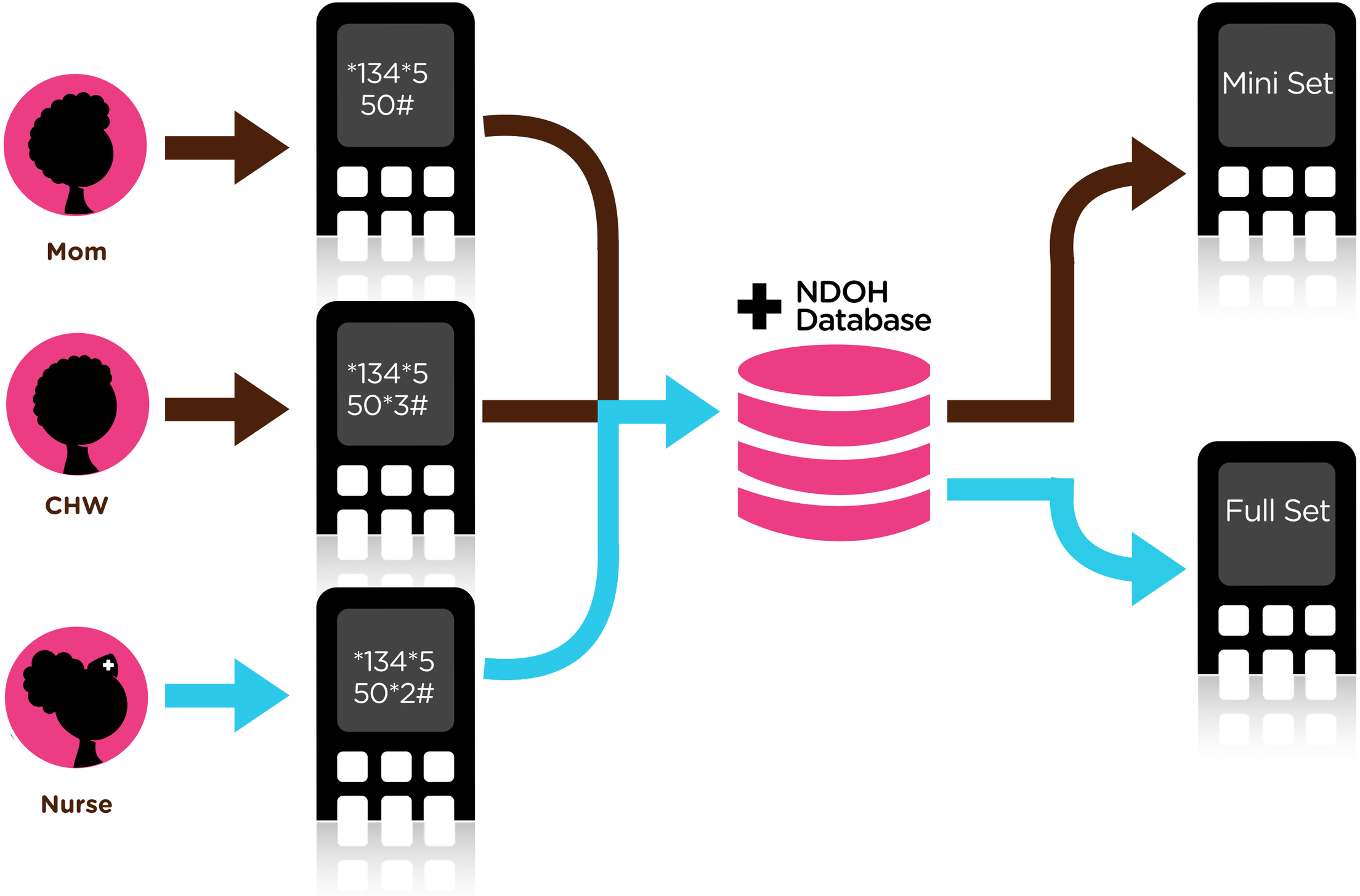
2. Nurse helps user register on their phone via USSD.

3. User answers questions about pregnancy.

4. User is registered.

5. Pregnancy is registered in the National Database

6. User receives weekly SMS messages to inform them of their pregnancy and baby health up to their child is 1 year old.


Mom
CHW
Nurse
*134*5
50#
*134*5
50*3#
*134*5
50*2#
NDOH
Database
Mini Set
Full Set

Full Set Messages

Week 5 - 30

Week 31 - 35

Week 35+

Baby

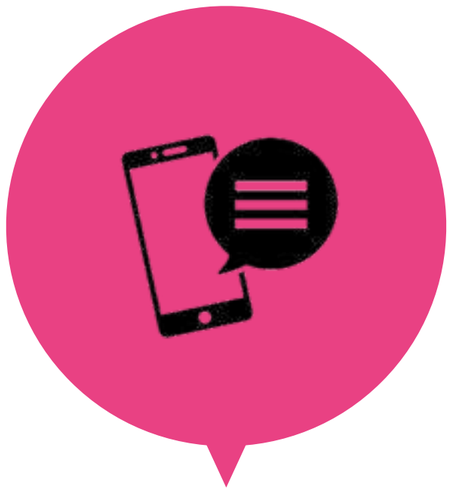
Pregnancy Messages

If a user signs up while they are pregnant they will receive stage-based messages relating to their week of pregnancy.

Pregnancy to Baby

Pregnancy messages will change to baby messages automatically at week 42. Mothers can also trigger the start of the baby messages by sending in the keyword ‘Baby’

Mini Set Messages



Inform

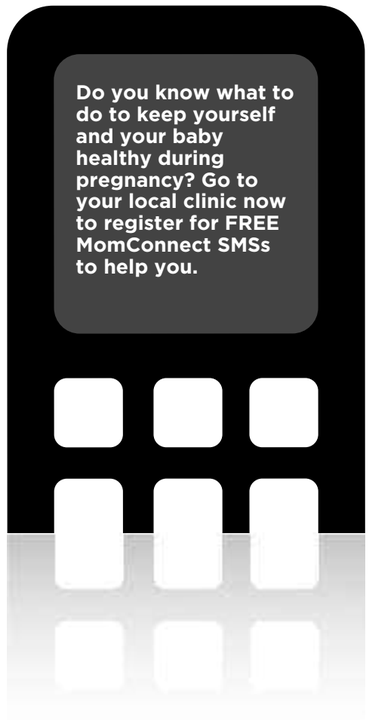
Message about MomConnect and what it offers.

Signal

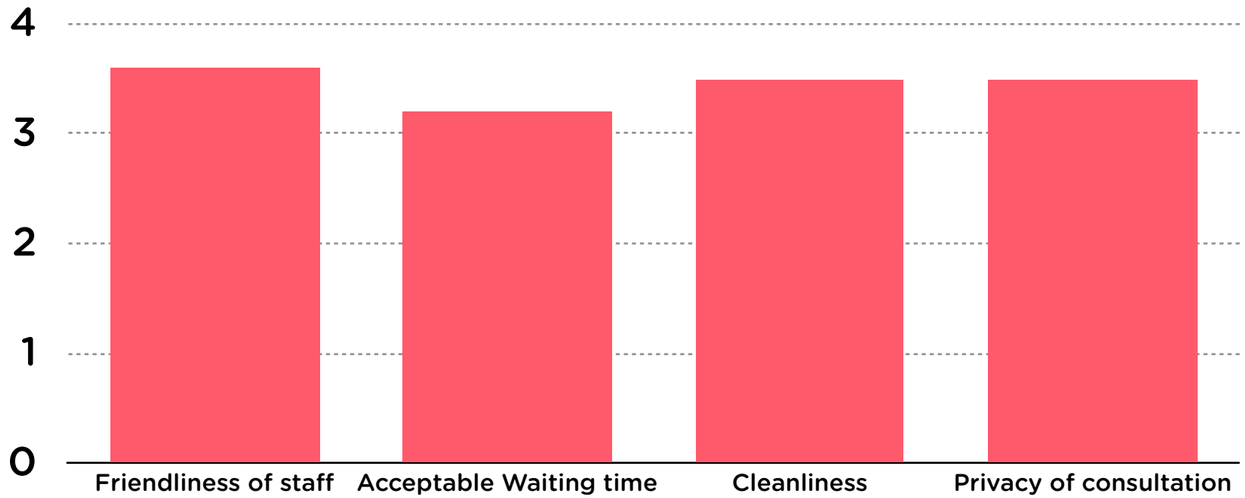
Messages to inform a mother of health concerns during pregnancy and to inform them that they can get help through MomConnect.

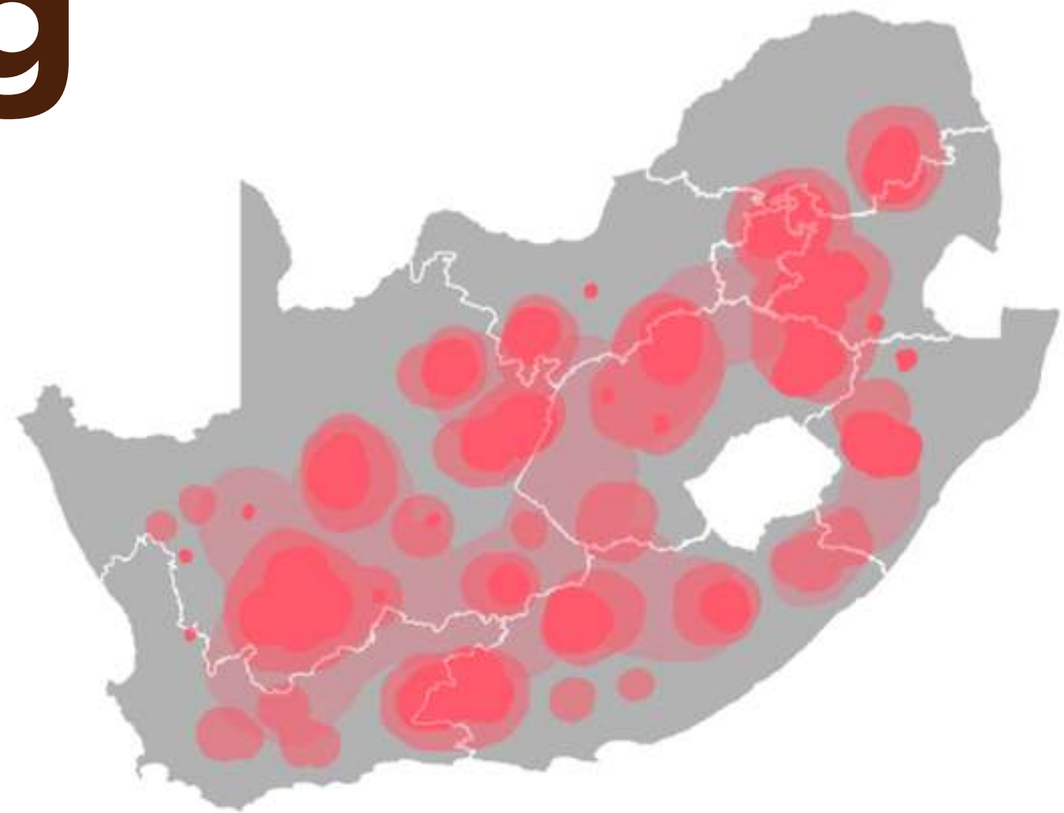
Trigger

Message to drive moms to a clinic to register their pregnancy and for MomConnect messages.



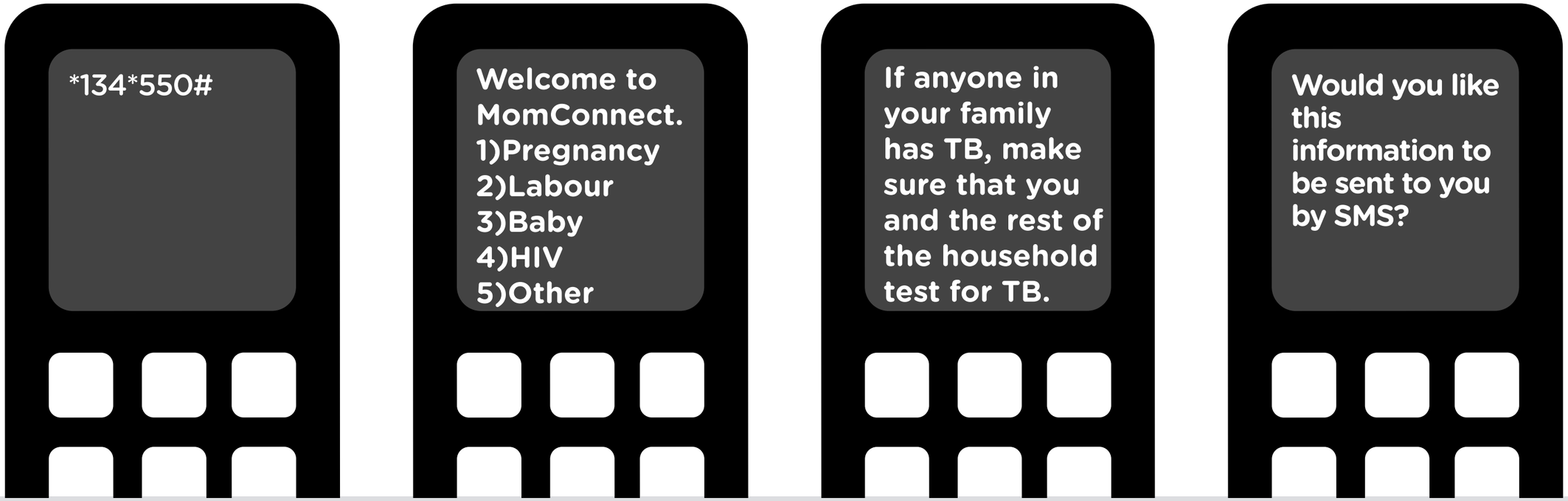
Service Rating





The day after the woman has registered she receives a message to ask her to rate the service she received at the clinic. This service rating is linked to the unique clinic code so that performance can be monitored on a clinic, district and province level.

Info Guides



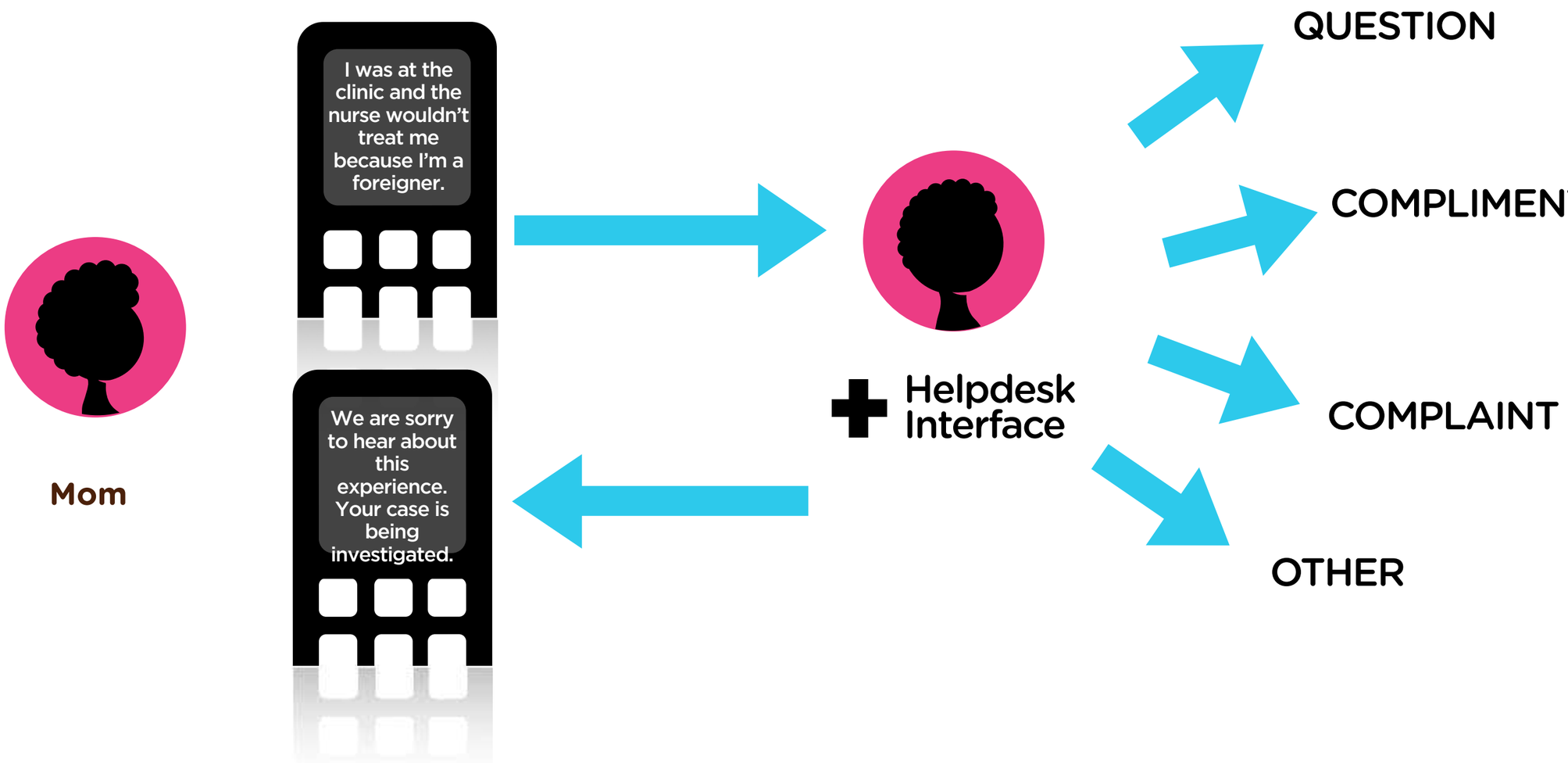
Dial

Browse

Find

SMS

Helpdesk



Mothers can send in any question, compliment or complaint to the helpdesk via SMS. Midwives at the NDOH then reply to these messages with prewritten, approved content through the Helpdesk Interface.

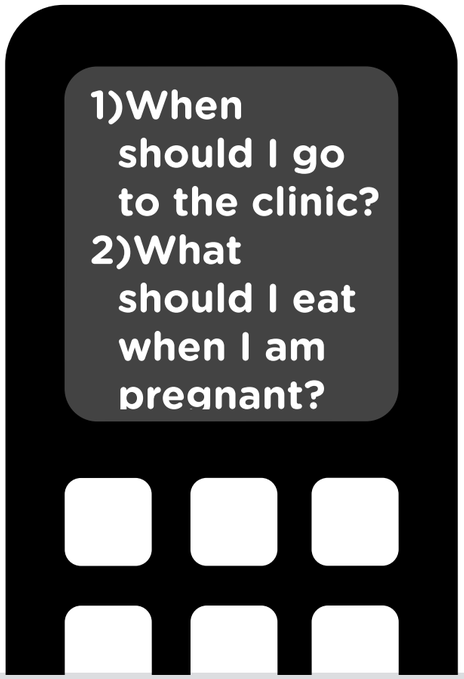
Opt Out

Opt Out

Users can opt out of the service at any stage by dialing the *134*550*1# line.

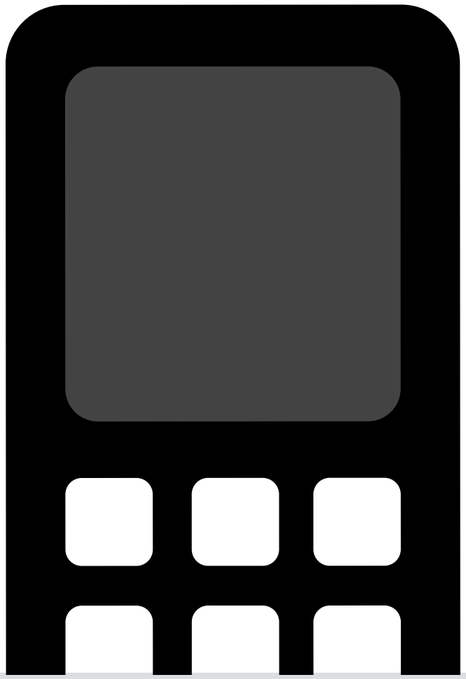
Reason for Opt Out

User indicates the reason they don't want to receive messages.



Death

Users opting out as a result of a miscarriage, still born or baby passing away will be given the option of receiving support messages.



Support Messages

7 support messages will be sent to the user to help them deal with the loss.

User Testing

"I smile because the information is so relevant and is about what my child is doing at that time. So I look forward to them. I wish they came in 5 times a week instead of just twice."

"It always gave me information about what I was going through at that time."

"It is very appealing. ... you know you can get reliable info. Which is not always what you get from the elderly people."

"I have friends that are pregnant and HIV positive who are not ready to tell people. So I have referred them to this service since it offers this information privately. I got them to register."

"If you were to be HIV positive, you would also need the information on how to deal with things. I think its better to...more than having a face to face with a counsellor where you have to disclose and explain. In a kind of way it is traumatic you understand. So this way is easier because it's not someone."

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Clinic Staff Feedback

"The SMSs are teaching moms that there are some things that you don't need to go to the clinic for"

"The messages really help us because it reminds mothers of the danger signs and helps them understand what they need to do"

"It saves the nurses time because moms don't have to ask as many questions because the SMSs give them the answers"

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Health
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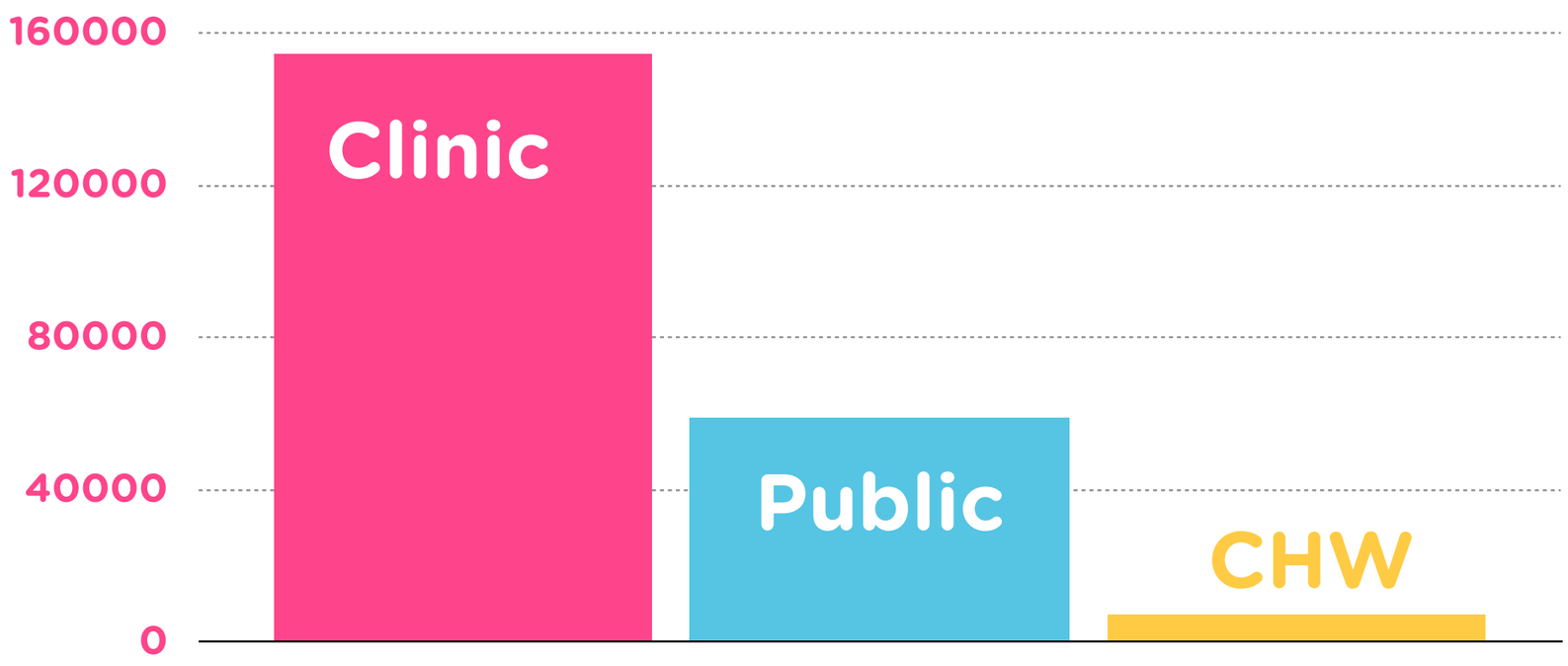
220 879



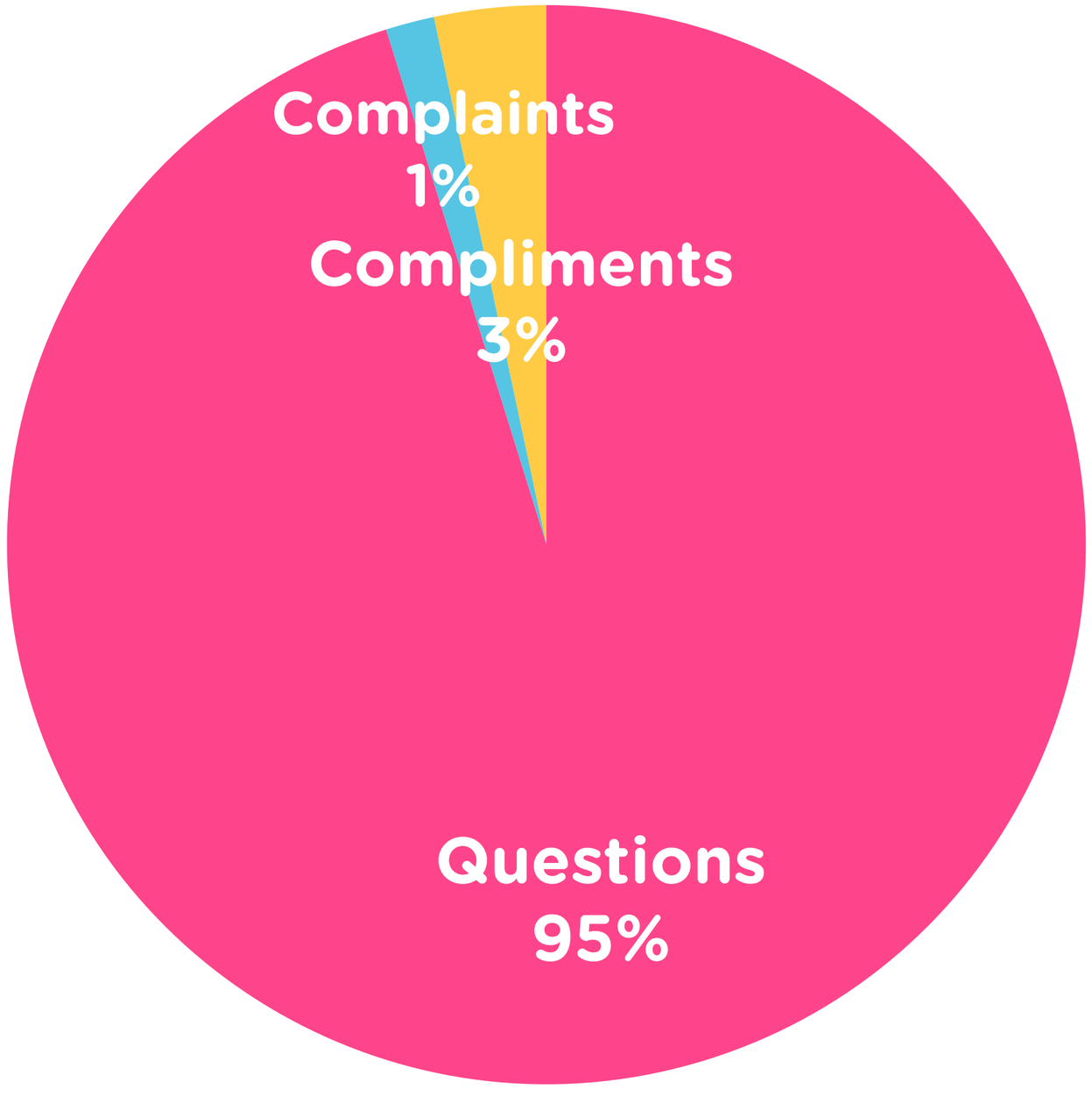
Since the launch of the service on 21 August 2014, MomConnect has registered over 200 000 mothers.

236 903

FAQs searched*

19 384

Messages to the Helpdesk



The vast majority of the messages sent to the helpdesk are questions about maternal and child health. All complaints and compliments are dealt with by point people at district and clinic level.

Universal.
Integrated.
Feedback.
Free.

MomConnect Service Registration Demonstration

134
550*2#

Welcome
MomConnect
Is this no.
(0749927190) the
mobile no. of the
pregnant woman to
be registered?
1. Yes
2. No

1

Please enter the
clinic code for the
facility where this
pregnancy is being
registered.

123456

Please Select the
month when the
baby is due:
1. Apr
2. May
3. Jun
4. Jul
5. Aug
6. Sept
7. Next

4

What day is the baby expected? (eg 14)

14

What kind of identification does the mother have?

1. SA ID
2. Passport
3. None

1

Please enter the SA ID no of the pregnant mother

8108010
017088

Please Select the language that the mother would prefer to receive SMSs in.
1. English
2.Afrikaans
3.Zulu
4.Xhosa

4

Thank you. The pregnancy has now been registered. The pregnant mother will now receive weekly

Welcome to MomConnect. For more info or to log a complaint or compliment, please dial *134*550#. If you ever want to stop getting SMSs

Control Interface

momconnect

- Debbie
- Dashboard
- Service Ratings
- Helpdesk
- Admin

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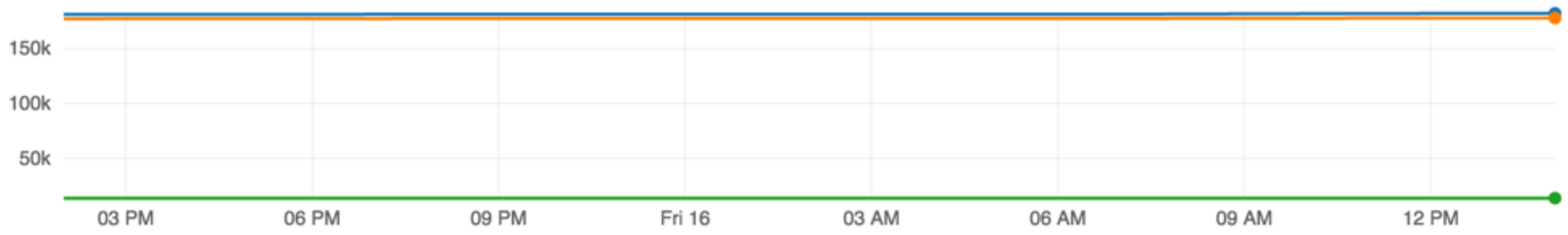
Dashboard

Unique Clinic Users (last 30 days)	Unique Personal Users (last 30 days)	Unique CHW Users (last 30 days)
182,296	178,104	13,948
+790 from 15 Jan 2:00 to 16 Jan 2:00	+434 from 15 Jan 2:00 to 16 Jan 2:00	+39 from 15 Jan 2:00 to 16 Jan 2:00

Unique Users (last 24 hours)



Unique Clinic Users	182,296
Unique Personal Users	178,104
Unique CHW Users	13,948

Snappy | Tickets | FAQ | Reports | Wall | MomConnect | You

0 → Yours 0 | Waiting 0 | Lens | Archive | Search...

an hour 2015-01-16 1pm	support@mom... support@momconn...	Re: Support for +27630100878 Thank you for your feedback on MomConnect. We appreciate it. From the national Department of Heal...		#compli...
an hour 2015-01-16 1pm	support@mom... support@momconn...	Re: Support for +27789966723 Please take you baby to the clinic.		#question
an hour 2015-01-16 1pm	support@mom... support@momconn...	Re: Support for +27791191790 Its not normal , please go to the clinic.		#question
an hour 2015-01-16 1pm	support@mom... support@momconn...	Support for +27781216854 Thank you		#other

Add Ticket | Batch Mode | Help

momconnect

thank you

Appendix E Additional MomConnect Training Material

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Summary: What number do you dial?

Number to dial from mobile phone	Who Dials it?	What does the line do?	Free to access?
***134*550#**	Pregnant Woman, on her own phone	This is the one stop line for all pregnant mothers to dial for MomConnect where they can get all the information they need. Pregnant women can dial this line to sign-up for a small set of messages about MomConnect AND access additional Baby and Pregnancy Info AND to log a complaint or compliment. Women still need to go to a clinic to sign up for the full set of messages.	Yes
***134*550*1#**	Pregnant Woman, on her own phone if she wants to opt out	This is the number that a women must dial if she wants to stop receiving messages for any reason (including loss of a baby or stillbirth). On this number the women can also inform us of why she wanted to opt out. Women can also opt out of receiving messages by replying 'STOP' to any of the messages she receives.	Yes
***134*550*2#**	Nurse/ Clinic Representative on any phone (e.g nurse's own phone; facility phone; mom's phone)	This is the only number where you can register a pregnant woman for the full set of messages. Only a Clinic representative can register a mother because a clinic code is needed to complete registration. Do not use this number for demonstrations and training. **Do not promote this number to mothers directly. This number is for facility use only.**	Yes
***134*550*3#**	CHW on any phone (e.g CHW's phone; mom's phone)	This number will allow a CHW to sign pregnant women up to a small set of messages about MomConnect. Women still need to go to a clinic to register for the full MomConnect program and full set of messages. **Do not promote this number to mothers directly. This number is for CHW-use only.**	Yes
***134*550*4#**	Pregnant woman, on her phone	The day after a pregnant woman registers at the clinic, she will get an SMS from MomConnect. In this SMS she will be asked to dial this number, to rate the service. Only women who have been fully registered for MomConnect, will be able to do this.	Yes
***120*550*0#**	Anyone during training on any phone	This number is for demonstrations, testing and training purposes ONLY. A pregnant woman will not be signed up to the programme if you use this number.	No - Costs 20c/20sec

How do women access the Helpdesk?

Women can dial *134*550# or reply to any SMS sent to them by MomConnect. She will then receive an SMS response from the Helpdesk.

How do women switch to baby messages once their baby has been born?

Women can reply to any message they have received from MomConnect with the word 'baby'. The Helpdesk will also respond with these instructions if she asks this question via SMS.

health

MomConnect troubleshooting guide

1. I was doing a registration but now it's not sending me any more question and I'm not finished.

What went wrong?

Your session timed out. This is when you take longer than 3 minutes to complete all the registration questions.

What can I do next?

Don't worry, you can always dial back in and start where you left off. You wont have to complete all the questions again.

2. I dial the line but there is an error message

What went wrong?

There are a number of things that could have gone wrong and we cannot supply you with a full list because it is different for every phone but here are some examples of the types of error messages you may get and what to do when you get one.

Message examples	What went wrong?	What can you do next?
Service Temporarily Unavailable Connection Failed	There are many reasons why this may happen. Sometimes its a network error and sometimes its a system issue.	1. First check if you have network coverage or reception. If you don't have reception you cannot use this system. 2. Check if someone on another network has the same problem. If they don't have the same problem, it may be an issue with your network. Use a phone on a working network until the error is resolved by the operator. 3. If you have reception and people on other networks are having the same problem, write down the error and report it to your point person.
E105 Error WASP Error Vumi Error	This is usually a problem with the system.	Write down the error and report it to your point person.
Other		1. First check if you have network coverage or reception. If you don't have reception you cannot use this system.

		2. Check if someone on another network has the same problem. If they don't have the same problem, it may be an issue with your network. Use a phone on a working network until the error is resolved by the operator. 3. If you have reception and people on other networks are having the same problem, write down the error and report it to your point person.

3. I'm trying to complete my registration like the SMS said but I'm not getting a response

What went wrong?

If you are not getting any response you may have tried to access the system incorrectly.

What can I do next

Make sure you are dialling in (like you are making a call to the number) and not sending an SMS with the number in it. The system only works if you dial the number.

4. I'm dialing the number but nothing is happening.

What can I do next?

1. First check if you have network coverage or reception. If you don't have reception you cannot use this system.
2. Check if someone on another network has the same problem. If they don't have the same problem, it may be an issue with your network. Use a phone on a working network until the error is resolved by the operator.
3. Check that you are dialing the number (like you are making a call to the number) and not sending an SMS to the number. The system only works if you dial the number.

5. I dialled the number but I don't get asked the right questions.

What happened?

There are a number of different numbers that you can dial and you may have dialed the wrong one.

What can I do next?

Make sure you dialled the right number. To register a mother for the full set of messages, dial *134*550*2# on any phone.

6. None of the above? This is the information you need to report a fault:

- Cellphone number you used to dial in

- Network - e.g. Vodacom; Cell C
- Did you have reception?
- Did you see an error message? If so, what was it?
- What phone did you use? (MAKE & MODEL)
- What USSD code did you dial?

Give this information to your point person and they will send this to Antonio Fernandes and Jane Sebidi so that they can follow up.

Note:
List of phones which cannot access USSD:
Windows 7 does not support USSD - or work on versions 7.5, 7.6, 7.7 and 7.8
e.g.s include: Nokia Lumia 505, 510, 610, 710, 800, 900; Samsung focus; HTC Titan

momconnect

Frequently Asked Questions

For Healthcare Professionals at Clinics

health

momconnect

health

General Questions

What is the National Department of Health Pregnancy Registry?

The NDOH is creating a national pregnancy registry. The aim of the registration of pregnant mothers to a central database is to provide them with valuable services which will improve maternal Health Indicators and to provide better statistical data with which to inform Governmental decisions around maternal health.

What is MomConnect?

MomConnect is the brand name given to the National Department of Health Pregnancy Registry. This name was previously used with a similar project in KZN involving the KZN Department of Health, Unicef, Virtual Purple and Praekelt Foundation.

How much does it cost to sign up?

It is completely free to sign up. Mothers will not be charged for the call to the USSD code (eg *134*550*2#) or for the messages that they will receive.

How much does it cost to receive the SMSs?

Mothers will not be charged anything to receive the messages. This service is free and will remain free.

Who is involved in the project?

There are many organisations involved in this project. These range from technical partners, to clinical implementation partners, funders and Mobile Network Operators as well as the clinic staff and Community Healthcare Workers. A complete list of these partners has not yet been finalised.

Does the mother have to belong to a certain mobile network to get the messages?

No. The mother will receive free messages no matter what network you belong to.

How long will the mother receive messages for?

The mother can sign up from 5 weeks of gestation and she will receive messages until her baby is 1 year old.

How will the impact of the service be measured?

The impact of the programme will be defined by key national maternal and child health indicators. These are specific to antenatal attendance, immunisations, mother and infant HIV testing with a particular focus on the 18 month PCR test as well as measures of behaviour change through

pre and post knowledge assessments. Process measures re the performance of the registry and support services will also be collected.

What is the difference between the messages a mother will get when she signs up herself, or through a CHW, or at a clinic?
If a mother signs up by herself through the *134*550# USSD code or a Community Health Worker signs her up through the *134*550*3# USSD code they will receive a set of 6 messages. These messages will tell the mother more about MomConnect and encourage her to go to the nearest clinic to sign up for the full set of messages. This full set of messages comprises of approximately 150 messages and the mother will receive between 2 and 3 messages per week. These messages are also stage based so that the mother will get information that is relevant to the stage of their pregnancy.

Is the mother's information safe?
Yes. The mother's information does not stay on the phone that she is using to register and is then sent to a secure database housed at the National Department of Health. This information is only used to improve health services and will not be shared with others.

Signing Mothers Up

At what point in the clinic process do we sign mothers up to the messages?

This is dependent on the situation at your clinic, however we have developed a number of options based on our knowledge of workflows at various clinics which will help to guide you when implementing this. Its important to remember that in order for a mother to be signed up she must have her pregnancy confirmed and an estimated due date.

Option 1:
In this scenario, mothers are first gathered together for their health education classes. These will usually be run by Health Promoters. At this stage it would be good to start to educate the mothers about the MomConnect Project, what it is and how they will sign up. The mother will then go into her consultation with the nurse and when she is in her consultation, the nurse should ask whether the mother would like to sign up to MomConnect. The mother's choice to sign up or not sign up should be recorded on her file by the nurse along with her EDD. When the mother hands her file back to the Data Capturer, the Data Capturer will then register the mother through the *134*550*2# code if she has decided to join the programme.

Option 2:

In this scenario, mothers are again gathered for their health education classes and at this point the Health Promoters educate the mothers about the MomConnect programme. However, once the consultation with the nurse is done, the file is left in the consultation room and the mother leaves the clinic without taking her file back to the data capturer. In this case the nurse should bath ask the mother if she wants to be part of the programme, and sign the mother up through the *134*550*2# code before she leaves the consultation. This should also be noted in the clinic file so that during future visits the mother is not asked to register again.

Option 3:
If no health education classes are offered and there is therefore no opportunity to talk to the mothers as a group about the MomConnect programme, it is suggested that a clinic staff member is tasked with handing out the informational fliers to mothers while they wait for their consultation. Then, in their consultation, the nurses will need to talk to the mother about the programme. The nurse can then sign the mother up through the *134*550*2# code or a data capturer can do this when the mother returns her file.

What happens if the mother does not want to get messages?

This is not a compulsory service and should the mother not want to sign up for messages she does not have to. However we suggest that you encourage mothers to sign up as this is a very valuable service for her and it will help you in the future too because the mother will be less likely to come to the clinic unnecessarily and will be able to make healthier choices during her pregnancy.

Who must sign up the mother?

Its important that a clinic employee signs the mother up because they will have received training on the process and will have access to information such as the EDD. However, this person can be a nurse, a data capturer, a health promoter or even a volunteer. The important thing is that the mother consents to being signed up, is confirmed as being pregnant by a nurse and that the nurse has given an estimated due date.

Who's phone do I need to use to sign up a mother?

You can use any phone to register a mother. This can be your own phone, a phone at the facility, the mother's phone or another patient's phone. Remember that you do not need airtime to use this service as it is completely free.

What happens if a mother has signed up through the CHW or Public line and then comes to the clinic?
The mother should be registered through the clinic USSD code (*134*550*2#) to start to receive the full set of messages for pregnancy. If they do not register through this code they will not receive these messages.

When can we start signing mothers up?
The launch date of this service has not yet been confirmed. You will be notified when the service is launched.

Why do mothers have to give their ID or passport number?
Mothers do not have to give their ID or Passport number if they do not wish to, however this allows us to know who they are so that if their information changes, we can identify them. This will also assist when they move between clinics and in the future will allow the National Department of Health to provide them with better service.

What happens if the mother does not have an ID or passport?
Mothers can still receive messages even if they do not have an ID or Passport.

What happens if there is no phone available or there is no signal at the clinic?
If there is no signal at the clinic or there is no phone available, the mother can be signed up to the programme using the paper based form that is provided for this purpose. In this event, the person at the clinic who would normally do the registration through the phone will be responsible for completing the paper based form. This information will be captured at the end of the day by someone identified by the facility manager in a computer identified for this purpose. This information will than collected by the District manager and sent to the Provincial Office and from there to the National Department cc the MCH coordinator.

What happens if the mother is not literate?
In the future we plan to develop a service that will cater for illiterate mothers, however at this point we can only deliver text messages. Please encourage the mother to get a literate friend to read her the messages until such time as a service for the illiterate is developed.

After Signing Up

How can the mother start getting messages about her baby now that she has given birth?
The messaging will automatically switch over to messages about her baby when the mother is 42 weeks pregnant. However in order to ensure that the messaging can start getting messages

about her baby when she gives birth, we suggest that the mother triggers the baby messages when she gives birth. This can be done by replying to any of the MomConnect messages that she has received with the word “Baby”.

What happens if the mother has a miscarriage or stillbirth?

If the mother wants to stop receiving messages for any reason including miscarriage or stillbirth, she can dial the opt-out code *134*550*1# . If she has had a miscarriage or stillbirth she can also choose to get a set of messages to support her through this time when she goes through this process.

What happens if the registered mother moves between clinics or attends another clinic after signing up somewhere else?

They will continue to receive messages and will not need to sign up again.

What happens if we want to update information about the mother? (eg change of EDD or change of phone number)

In the future we will make it possible to easily update a patient’s information, however currently if a mother wants to change anything (eg language, cell number or EDD) then they need to re-register. If the mother inputs her ID or Passport number it helps us to make this re-registry more effective.

What happens if the mother loses her phone or gets a new phone number?

It is important to remember that the messages are linked to the phone number (SIM Card) and not the phone. If a mother loses her phone she has 2 options:

1. She can get a sim swap through her mobile service provider so that she transfers her number to a new sim card. This will mean that she will still get the messages as usual and she will not need to do anything.
2. If she gets a new phone number she can re-register to receive messages on her new number. This will entail going through the full registration process at the clinic again.

How does the mother stop receiving messages?

If a mother wants to stop receiving messages she must dial *134*550*1#. She will be asked for her reason for opting out and will stop receiving messages. If she has suffered a miscarriage, stillbirth or death of a baby she can also choose to get messages to help support her through this time at this point.

Who’s phone do I need to use if I want to opt a mother out or change their messages to the baby messages now that they have given birth?

The mother must use her own phone to opt out of messaging or to change over to baby messages.

What happens if the mother wants the messages in another language?

We currently offer messages in English, Afrikaans, Zulu, Xhosa, Sotho and Setswana. The service will be offered in all 11 languages in the future however these are not available as yet. If a mother wants to change the language she is receiving the messages in, she will have to go to the clinic and re-register through the *134*550*2# number.

Beyond the SMSs

How can a mother get more information about her pregnancy or baby?

She can dial the free number *134*550# to access baby and pregnancy information. This is available to all mothers, even those who have not registered through the clinic.

How can a mother rate the service she received at the clinic?

Once a mother has registered at the clinic she will receive an SMS that explains how she can rate the service she has received.

How can a mother log a complaint about the service?

The mother can dial the free number *134*550# to log a complaint. This is only available to mothers who have registered through a clinic.

How can a mother give a compliment about the service?

The mother can dial the free number *134*550# to log a compliment This is only available to mothers who have registered through a clinic.

What are the future plans for the project?

Future plans for the project include:

- Messages available in all 11 official languages
- A voice programme for those who are illiterate
- The ability to register through other channels such as fieldworker applications and Mxit