

The CommCare Evidence Base

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CommCare: The Most Evidence-Based Mobile Tool for Frontline Workers

44 papers have been written about CommCare and related systems, including 21 published studies about CommCare. These papers support evidence that equipping Frontline Workers (FLWs) with mobile phones increases quality of care, experience of care, accountability of services, and clients' knowledge, attitude, and/or practice.



CommCare

Executive Summary

CommCare (www.commcarehq.org) is an open source mobile and web cloud product used by Frontline Workers (FLWs) across a variety of sectors, including community health workers, agricultural extension workers, mobile trainers, and supervisors. CommCare replaces cumbersome paper registers, reporting forms, and client education flipcharts with an open source cloud product that can run on simple Java enabled phones, as well as higher end android smart phones and tablets. With over 12,500 registered mobile users in 35+ countries that are part of active mobile projects, CommCare is one of the most widely adopted and technically advanced mobile platforms for FLWs.

It is also the most evidence based mobile health tool available for these frontline workforces. We reviewed all published paper and unpublished (grey literature) studies about the CommCare platform, in addition to all published papers on pertinent, alternative mobile systems, and several papers on highly relevant topics.

This collection of 44 papers offers substantial evidence that CommCare improves access to, quality, experience, and accountability of services provided by FLWs and directly impacts clients' knowledge, attitude, and/or practice. It also demonstrates that when a mobile tool like CommCare is deployed, "the effect on the program extends beyond the tool, acting as a forcing function for wide program and organizational level change" [Bhavsar, 2014].

Although there is no definitive study showing an improvement in health outcomes from adopting CommCare, the collective evidence base makes a convincing case that, when used correctly, CommCare's system can improve community programs, both in the health and non-health domains. Overall, FLWs have reported that CommCare makes their job easier and has helped them gain more respect from clients in their community.

Highlights

Pregnant women that access CommCare are **20%** more likely to access antenatal care and **22%** more likely to have skilled deliveries. [Afghanistan, 2013]

CHWs that use CommCare have home visits that are **1.7x** longer, and are **2.6x** more likely to include the client's husband. [India, 2013]

Cardiovascular Disease screening trainings took 12 hours with paper tools, versus **3 hours** with CommCare. [South Africa, 2013]

CommCare feedback increases FLW visit timeliness by **85%**. [Tanzania, 2012]

In a study of 1,221 children, only **20.7%** of children were assessed for all ten IMCI areas with paper protocols, compared with **70.9%** with CommCare. [Tanzania, 2013]

After four months of using CommCare, CHWs increased knowledge of danger signs in all major health categories by **22%**. [India, 2012]

CommCare resulted in **higher** medicine dosing accuracy [Mexico & Guatemala, 2013]

Clinicians that use CommCare completed **20%** more of required protocol steps [Tanzania, 2008]

FLWs are **more likely** to select CommCare over paper –based tools [Mexico & Guatemala, 2013]

Critical Properties for Frontline Worker (FLW) Applications

There are three critical properties of successful mobile applications for FLWs (Figure 1).

Client Tracking allows FLWs to register and track clients over time. A client list is maintained on the phone as a longitudinal record for each client. This means that a client such as a pregnant mother can be registered and followed up with multiple times. Client tracking is an important feature for FLWs to conduct visits that requires complex workflows.

Decision Support is used by FLWs to improve the quality of home visits through electronic checklists, as well as step-by-step guidance through protocols. Applications that use decision support must be able to include different types of questions and contain complex logic. Examples of this include following standard protocols, calculating algorithms for screening tools, and supporting diagnostics.

Mounting evidence shows that **multimedia** increases client experiences. Images, audio, and videos are integrated into applications to facilitate transfer of knowledge and improve service delivery.

Because these are critical properties, mobile systems that did not feature all three properties are not included in this review. We exclude simple data collection systems (e.g. Open Data Kit (ODK), Magpi), as well as applications that do not connect to the Internet, such as pure SMS applications for FLWs (e.g. Rapid SMS). While these applications bring their own advantages, they provide a fundamentally different value proposition and were considered to be separate from the complex workflows that are necessary for FLWs.

Related & Alternative Systems

The papers we included that are not about CommCare can be divided into two categories: **Related Systems** and **Alternative Systems**.



Figure 1. The three critical properties of CommCare and other successful mobile platforms for frontline workers include the ability to track clients over time, support decision-making, and the inclusion of multimedia

Papers on **Related Systems** report on systems that are not currently supported by an organization, including early work on PDA-based systems that are considered to be precursors to CommCare [DeRenzi, 2008] [Mitchell, 2012] [Mitchell, 2013]. Related Systems also present a flexible approach for using CommCare in collaboration with other systems, such as DHIS 2.0 and OpenMRS to increase scalability of programs [Braa, 2010].

Alternative systems are currently supported by other organizations and share the critical properties described above. The alternative applications we examine in this evidence base are mobile applications developed by D-tree International, MedicMobile, eMocha, Virtuosos, Vodafone, Mezzanine, and Mobenzi. In an effort to identify all available published papers, we corresponded directly with several creators of these mobile application systems. Note that D-tree International supports an alternative software application in addition to having contributed to several CommCare-related publications, though there are no publications on alternative systems.

Levels of Evidence

Papers are categorized by their level of evidence and organized by the paper's rigor in addressing whether CommCare can improve client health outcomes (Figure 2). Level 6, the final level of evidence, refers to a study that demonstrates an mHealth system has an impact on client outcomes. Note that because CommCare is used across several sectors, only health-related studies could fulfill the Level 6 criteria. At this point, there are no Level 6 studies that demonstrate mHealth system impacts clients' health outcomes.

There are a total of 21 published papers on CommCare, 15 unpublished papers on CommCare, three papers on alternative systems, and five on related systems (four of which are a PDA-based precursor to CommCare). This review did not include unpublished studies on alternative

Level of Evidence	CommCare		Published Alternative	Published Related	Total
	Published	Unpublished			
Conceptual	4		1		5
Implementation Narrative	7	2	2		11
Qualitative Interviews	3	5		1	9
Frontline Worker (FLW) Process Improvement	6	4		4	14
Client Knowledge, Attitude, Practice (KAP)	1	4			5
Total	21	15	3	5	44

Figure 3. Total # of published & unpublished papers in the evidence base. or related systems to CommCare (Figure 3).

Of the 44 studies included in the evidence base, 16 were conducted in India and another nine were conducted in Tanzania. These are the two countries that Dimagi and D-tree International have most widely implemented CommCare. CommCare was first developed and tested in Tanzania, and India has the largest number of CommCare projects in the world. 14 of the studies in the evidence base were put out in 2012.

Level of Evidence	Description
1. Conceptual	<i>Discuss the theoretical possibilities and justification for CommCare but aren't tied to any particular intervention or system implementation</i>
2. Implementation Narrative	<i>Describe the process and lessons learned from system implementation, with little or no rigorous evaluation</i>
3. Qualitative Interviews	<i>Qualitative interviews, most often with field level workers using a mobile tool</i>
4. Frontline Worker (FLW) Process Improvement	<i>Include quantitative changes to FLW processes or behavior, such as visit rates, data completeness etc.</i>
5. Client Knowledge, Attitude, Practice (KAP)	<i>Present evidence that mobile system directly impacts client knowledge, attitude, and/or practice</i>

Figure 2. Evidence levels based on the rigor in addressing whether CommCare can improve client health outcomes

The Four Pillars of Evidence

The CommCare Evidence Base is organized into four pillars. Each is based on how CommCare influences clients' knowledge, attitude, and practices (Figure 4).

Before anything, the evidence base looks at FLWs' and clients' perceived **Acceptability and Feasibility** of CommCare. This refers to whether CommCare is well received by FLWs and clients across geographical regions and types of programs. Barriers to this include that CommCare is too difficult to use, not intuitive, or that FLWs or clients are skeptical or hesitant to use CommCare. Before any other evidence can be established, it is important to demonstrate that CommCare is well received as a system by FLWs and clients.

The first pillar is to expand **Access** to care for clients. Access can be defined as how often and for how long a client meets with a FLW. Common barriers to access include high FLW turnover rates, FLWs not enrolling all eligible clients in their catchment areas, FLWs not conducting necessary visits after enrolling eligible clients, and FLWs spending limited time with clients during visits.

The second pillar seeks to increase the **Quality** of care clients receive when seeking out services. We define quality of care in terms of whether a client receives complete and accurate information, and if their FLWs make the necessary assessments and decisions and propose well-informed recommendations and follow-up steps. Common barriers to delivering high quality services include a lack of training for new or replacement FLWs, FLWs failing to administer all counseling information due to sensitive topics or limited time, and inaccurate clinical assessments that are the result of poor measurement tools or lack of motivation to act upon the assessment.

The third pillar is to improve the **Experience** clients have when receiving care. For the purpose of this evidence base, we define experience of care by a client's level of engagement during a FLW visit and the degree to which the client finds their FLW

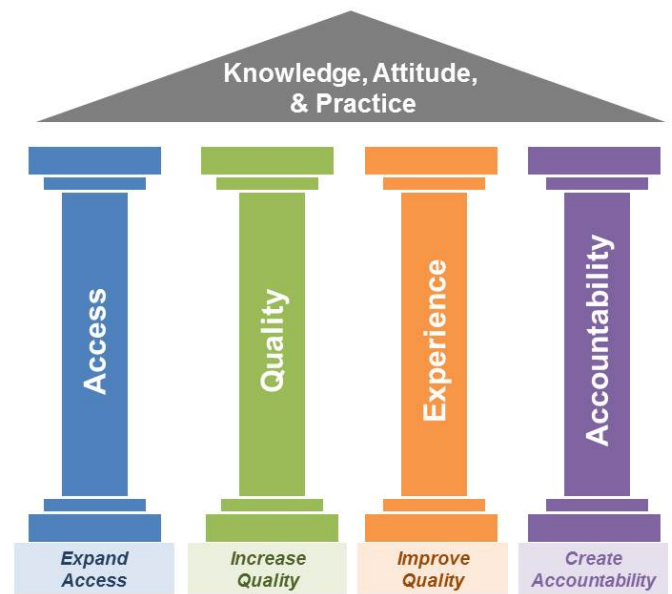


Figure 4. The four pillars of the CommCare Evidence Base.

persuasive. Common barriers to high experience of care include if a FLW doesn't carry or misuses promotional materials and if they have low credibility in their community.

The fourth pillar aims to create **Accountability** and is defined as providing more visibility into FLWs' job-related activities. Common barriers to high accountability of care include redundant and misused paper registers, data that is filled out solely for reporting purposes, and delays in compiling and reporting data. CommCare has the potential to dramatically improve accountability of care by providing nearly real-time reports about each interaction between an FLW and a client—with a level of detail and speed that is far beyond what even the best paper reporting systems can accomplish.

CommCare is designed to be used by FLWs, and accordingly, all four pillars demonstrate how CommCare improves FLWs' processes and behaviors. While improving FLWs' processes and behaviors is important to any frontline program, a primary goal of frontline programs is to increase clients' positive behaviors. In this evidence base, Level 5 studies demonstrate how CommCare contributes to improving **Client Knowledge, Attitude, & Practice** in the clients that FLWs serve.

Table of Articles Included in Evidence Base

Level	Lead Author	Highlights	Year	Platform	Published	Country
1	Bollinger	<i>Describes potential for smart phone applications to empower health workers and the need for evaluation</i>	2011	eMocha	Published	Many
1	Braa	<i>Presents flexible approach for utilizing DHIS2.0, OpenMRS, and CommCare together</i>	2010	CommCare	Published	Sierra Leone
1	DeRenzi	<i>Presents case management framework</i>	2011a	CommCare	Published	Unspecific
1	DeRenzi	<i>Outlines six key functions for mobile health (mhealth)</i>	2011b	CommCare (& others)	Published	Unspecific
1	Routen	<i>Describes how to use CommCare to support family planning</i>	2010	CommCare	Published	Unspecific
2	Bhavsar	<i>Drawing from survey of 34 CommCare users in India to present a mobile design framework</i>	2014	CommCare	Published	India
2	Bogan	<i>Overview of CommCare applications in Tanzania</i>	2009	CommCare	Published	Tanzania
2	Chaiyahati	<i>Five-fold increase in adverse event submission rates using CommCare compared to paper</i>	2013	CommCare	Published	South Africa
2	Mangilima	<i>Case study of CommCare in Tanzania</i>	2010	CommCare	Published	Tanzania
2	Mhila	<i>Case study of CommCare in Tanzania</i>	2009	CommCare	Published	Tanzania
2	Schuttner	<i>Demonstrates that CommCare helped improve linkages between community and clinic</i>	2011	CommCare	Grey/Poster	Zambia
2	Tomlinson	<i>Mobile phone-based information system platforms offer significant opportunities to improve CHW-driven interventions</i>	2013	Mobenzi	Published	South Africa
2	Treatman	<i>Case study of CommCare in India</i>	2012	CommCare	Published	India
2	Tumwebaze	<i>eMocha facilitates Household-Based HIV Counseling and Testing program</i>	2012	eMocha	Published	Uganda
2	Wilson	<i>CommCare helped FLWs follow up with referred TB symptomatics reduced communication delays for test results, and reduced the number of FLW visits to diagnostic centers</i>	2013	CommCare	Grey/Poster	India
3	Bhavsar	<i>FLWs reported their clients were more attentive and trusted audio messages in CommCare more than what the FLWs themselves were saying</i>	2012	CommCare	Grey	Guatemala
3	Chittamuru	<i>CommCare lent credibility to the message of FLWs. CommCare allowed FLWs to work around cultural and social barriers when</i>	2012	CommCare	Published	India

		<i>discussing sensitive or taboo</i>				
3	Flaming	<i>CommCare strengthens ASHA workflow by improving ASHA performance, improving the ASHA-beneficiary interaction, changing health norms in community, and improving the monitoring of ASHAs within the health system</i>	2014	CommCare	Grey	India
3	Mitchell	<i>Electronic protocols well received by clinicians and clients</i>	2012	Related	Published	Tanzania
3	Ortiz	<i>CommCare saves FLWs time calculating children's nutritional status; reduced time for data to be available</i>	2014	CommCare	Grey	Madagascar
3	Schwartz	<i>CommCare informs client counseling sessions, tracks clients, and helps ASHAs deliver appropriate information</i>	2013	CommCare	Published	India
3	Treatman	<i>Multimedia improves experience for clients and FLWs</i>	2012	CommCare	Published	India
3	Vijaykumar	<i>Use of CommCare improves FLW credibility</i>	2012	CommCare	Grey	India
3	Wise	<i>Collected qualitative feedback about CommCare from Village Workers in Maharashtra, India</i>	2013	CommCare	Grey	India
4	Birnbaum	<i>Algorithms can detect outliers and identify FLWs who are submitting false forms</i>	2012	CommCare	Published	Tanzania
4	CRS	<i>FLWs' knowledge of high impact MNCH interventions increased by 24% after five months CommCare improves counseling quality and family's receptiveness of counseling</i>	2013a	CommCare	Grey	India
4	DeRenzi	<i>Electronic guidance increased adherence to clinical protocols by ~20%</i>	2008	Related	Published	Tanzania
4	DeRenzi	<i>Reminders and escalation to supervisor increased timeliness of visits by 85%</i>	2012	CommCare	Published	Tanzania
4	IntraHealth	<i>FLW knowledge of at least 3 of 5 danger signs improved from 48% to 70% after four months of using CommCare</i>	2012	CommCare	Grey/ Poster	India
4	Medhi	<i>9 of 10 FLWs self-reported improved social respect in community from using CommCare. CommCare reduced average time to get data to program coordinator from 45 days to 8 hours. CommCare improved data completeness from 67% to 84%</i>	2012	CommCare	Published	India
4	Mitchell	<i>Counselor using an electronic protocol can effectively screen HIV patients (i.e. task shifting)</i>	2012	Related	Published	South Africa
4	Mitchell	<i>Pre-cursor to CommCare improved the consistency, accuracy and completeness of IMCI assessments. Study found only 20.7% of children had all ten IMCI items assessed using paper-based IMCI protocols,</i>	2013	Related	Published	Tanzania

		<i>compared to 70.9% with eIMCI</i>				
4	Mohamed	<i>CommCare increases the duration of client visits and engages more decision makers</i>	2014	CommCare	Published	India
4	Nascimento	<i>CommCare is more efficient, effective, and cost-effective tool than paper systems in conducting searches for HIV/AIDS patients that defaulted on ARTs, missed appointments, or lab test dates.</i>	2014	CommCare	Grey	Mozambique
4	Palazuelos	<i>Medicine dosing accuracy using CommCare was higher than using paper tool; CommCare enhances FLW credibility with communities</i>	2013	CommCare	Published	Mexico/Guatemala
4	Pathfinder	<i>Integrating CommCare lead to improvements in quality of ANC care by CHEWs, improved quality scores related to frequency that CHEWs performed technical aspects of care, and a strong effect on counseling provided by CHEWs.</i>	2014	CommCare	Grey	Nigeria
4	Ramachandran	<i>Videos on phones engage clients and their families</i>	2010	Related	Published	India
4	Surka	<i>CommCare enhances screening for CVD by enabling faster and easier trainings, more efficient screenings, and by reducing the margin of error in calculating CVD risk scores compared to the paper-based tools</i>	2014	CommCare	Published	South Africa
5	CHS	<i>Sharing family planning counseling with CommCare led to increased demand for family planning services</i>	2013	CommCare	Grey	Benin
5	CRS	<i>Over five months, a CommCare project saw a 33% increase in clients who asked questions during visits (from 24% to 57%)</i>	2013b	CommCare	Grey	India
5	Hoy	<i>An intervention including CommCare achieved an institutional delivery rate of 71% compared to the regional average of 32%.</i>	2014	CommCare	Published	Tanzania
5	WorldVision	<i>Pregnant women that had access to CommCare had a higher likelihood of accessing antenatal care, have births assisted by a skilled provider, know pregnancy danger signs, seek care at a facility, and be more prepared for birth (64%) than in five similar studies, where rates varied between 7% and 48%.</i>	2012	CommCare	Grey	Mozambique
5	WorldVision	<i>CommCare is attributed with an improvement in women who received antenatal care (20%), had skilled deliveries (22.3%), had birth plans that coordinated with a facility (12.6%), and who had increased knowledge of pregnancy danger signs (12.6%)</i>	2013	CommCare	Grey	Afghanistan

Findings

Although there is no definitive study showing an improvement in health outcomes from adopting CommCare, the collective evidence base suggests that, when used correctly, CommCare's system can improve community programs, both in the health and non-health domains.

Acceptability & Feasibility

Several published case studies about CommCare provide clear evidence that the system is well received by FLWs and clients across different geographical regions and types of community programs [Mhila, 2009] [Bogan, 2009] [Mangilma, 2010] [Treatmen, 2012]. It is clear that CommCare can be introduced into FLW programs successfully, although a program's ability to maintain enthusiasm for the system is a separate question. This is validated by several studies that have conducted qualitative interviews with FLWs using CommCare in Tanzania, India, and Guatemala [Mhila, 2009] [Bhavsar, 2012] [Chittamuru, 2012] [Treatman, 2012] [Vjaykumar, 2012]. A study of FLWs in Mexico and Guatemala found that FLWs were more likely to choose CommCare over a paper-based tool, and 94% of FLWs found CommCare to be easy to use [Palazuelos, 2013]. An evaluation of a nine-FLW CommCare pilot in Madagascar found that all of the FLWs preferred CommCare to the paper-based system, primarily because it both reduced their workload and made it easier to complete tasks (including tracking clients and performing weight-for-age z-score calculations [Ortiz, 2014].

Overall, FLWs have reported that CommCare makes their job easier, has helped them gain more respect from clients, and even family members at home. In one study in India, children and husbands of FLWs in India reported that the device signals that the mother/wife "does important work" [Schwartz, 2013]. While these results are partially biased due to the fact that interviewees typically want to speak more favorably about CommCare, they are still highly encouraging.

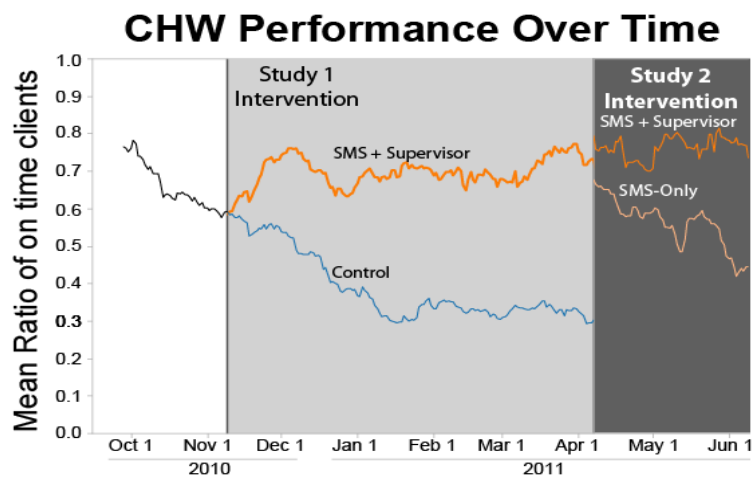


Figure 5. Example of improved performance of Community Health Workers (CHWs) over time increasing access to care by providing 85% more timely visits in a randomly controlled trial [DeRenzi, 2012].

Access to Care

Several studies have looked at how CommCare improves clients' access to care, including increasing FLW visit frequency and reducing missed appointments. A randomized controlled study in Tanzania found that feedback generated from data collected by CommCare increased FLW visit frequency [DeRenzi, 2012]. The approach hinges on the fact that FLWs' visits are reported in near real-time to a central server, CommCareHQ. FLWs can be encouraged to perform a visit until visit data is reported. The study found that SMS reminders that were escalated to a supervisor in the case of a missed visit improved FLW visit timeliness by 86%, compared to CommCare-using FLWs who did not receive SMS reminders (Figure 5). CommCare has also been deployed in Zambia to help FLWs improve follow-up rates at clinics. The preliminary investigation showed that:

"The system widely penetrated into the pilot communities, and showed functioning linkages between community and clinic." [Schuttner, 2001]

In India, CommCare helped reduce delays in the time it takes to follow up with TB patients and communicate TB test results [Wilson, 2013]. A study by MEASURE Evaluation in Mozambique found that CommCare was more efficient, effective, and cost-effective tool than traditional paper systems in conducting searches for HIV/AIDS patients that defaulted on their ARTs, missed appointments, or lab test dates. [Nascimento, 2014].

Another study in Mozambique found that pregnant women whose Community Health Volunteers (CHVs) used CommCare had a higher likelihood of accessing antenatal care and have their births assisted by a skilled provider than women in the control group [World Vision, 2012]. Study results from Afghanistan showed a 20% improvement in antenatal attendance and a 22.3% improvement in the number of women receiving skilled deliveries at a health facility. The same study also noted that equipping non-literate CHVs with mobile phones allowed them to have:

“Better access and deliver medical supplies during the winter months, in addition to making referrals to health facilities” [World Vision, 2012]

A study of 25 FLWs using CommCare and 25 not using CommCare in Kaushambi, Uttar Pradesh investigated how long FLWs spent with their clients and who attended the counseling sessions. The results showed that sessions led by FLWs using CommCare are on average 1.7 times longer, 2.6 times more likely to include the client's husband, and 1.6 times more likely to include the client's mother-in-law than counseling sessions led by FLWs that do not use CommCare. Qualitative interviews from the study also confirmed that CommCare attracts family members to counseling sessions [Mohammed, 2014].

A recurring theme in the CommCare literature is that CommCare reduces the time it takes FLWs to participate in trainings or complete job-related tasks, which could possibly enable them to see more or spend more time with clients. A study in South Africa found that FLWs that use paper-based tools during trainings for cardiovascular disease screening (CVD) took four times longer to complete than the trainings where FLWs used CommCare (12.25 hours compared to 3 hours). When it came to the actual screening of clients, it took FLWs using the paper tool an average of 36 minutes to complete one screening, compared to 21 minutes for a FLW using CommCare [Surka, 2014].

Quality of Care

The quality of services an FLW provides is based upon them knowing and being comfortable delivering correct information to clients. One study in India demonstrated that, after a period of four months of use, FLWs had increased their knowledge retention of at least three to five danger signs across all key health categories from 48% at baseline to 70% [IntraHealth, 2012]. A separate pilot project of 111 Accredited Health Social Activists (ASHAs) in Kaushambi, India found a 24% improvement in ASHAs' knowledge of high impact maternal and newborn care interventions since first using CommCare five months earlier [Mohamed, 2014]. Other FLWs in India have self-reported better knowledge retention as a result of using CommCare, which has been helpful in presenting complex and sensitive topics [Chitamuru, 2012].

A prominent trend in the CommCare evidence base is that CommCare can supplement FLW training. A controlled trial in 2008 in Tanzania tested a PDA-based precursor to CommCare (eIMCI) that contained an electronic version of Integrated Management of Childhood Illness (IMCI) protocol for classifying and treating common causes of child mortality (Figure 6). The trial results indicated that clinicians using electronic guidance completed on average 20% more of the required steps than clinicians that did not use electronic

guidance [DeRenzi, 2008]. Likewise, a study of 17 FLWs in Mexico and Guatemala found the use of CommCare consistently resulted in a higher medicine dosing accuracy compared to a paper-based tool during a dosing practice test [Palazuelos, 2013].

At the clinical level, CommCare has been shown to improve the consistency, accuracy, and completeness of clinical assessments. In the same study, it was discovered that the proportion of completed assessments for each of the 10 critical IMCI items ranged from 61%-98% using paper-based protocols, compared to 92-100% with the CommCare precursor (eIMCI). Only 20.7% of the 1,221 children in the study had all ten IMCI items assessed with paper protocols, compared with 70.9% that had electronic guidance. The CommCare precursor also resulted in more accurate disease classification (90.9%) compared to paper (82.7%), and clinical assessments that use CommCare are more consistent across clinics [Mitchell, 2013]. In Nigeria, Pathfinder International found that CommCare increased the quality score for ANC visits from 13.3 at baseline to 17.2 at the endline ($p < 0.0001$), out of a possible score of 25. The study cited that, with CommCare, there was an improvement and increase in CHEWs counseling beneficiaries and an increase in the frequency at which CHEWs performed more technical aspects of care. [Pathfinder 2014].

Experience of Care

CommCare applications typically make extensive use of multimedia, especially images and audio clips that are recorded locally by native speakers. CommCare also supports videos, although these are less common due to production expenses. The literature indicates that multimedia usage in CommCare increases client engagement [Treatman, 2012]. These findings corroborate with earlier work that shows that videos played by FLWs on phones helped engage clients and other decision-makers in the client's family [Ramachandran, 2010].

Several studies have shown that CommCare improves FLWs' personal credibility and the credibility of the health messages they deliver [Chitamuru, 2012] [Vijaykumar, 2012] [Bhavsar, 2012] [Medhi, 2012] [Schwartz, 2013] [Ortiz, 2014]. These findings have emerged from qualitative interviews with FLWs, who have reported that CommCare has enhanced their credibility in their community, and clients and their families perceive recorded messages as more trustworthy. CommCare is widely viewed as an independent, objective source of information, which greatly benefits FLWs' ability to deliver sensitive health messages. An FLW can act more as a trusted mediator in addressing the listeners' questions with the phone's messages. On the other hand,

Indicators	Paper-based tools	CommCare	p-value
Vomiting	66.7% (n=24)	86% (n=28)	-
Chest indrawing	75% (n=20)	94% (n=18)	-
Blood in stool	71% (n=7)	100% (n=3)	-
Measles in last 3 mos.	56% (n=9)	95% (n=21)	< 0.05
Tender ear	0% (n=1)	100% (n=5)	-
All	61% (n=299)	85% (n=359)	< 0.01

Figure 6. Clinicians that used CommCare completed 20% more required protocol steps (Tanzania, 2008)

concerns are noted that the use of CommCare to play health messages to clients can reduce interaction if the FLW simply plays the audio clips without initiating a follow-up discussion.

CommCare has also been shown to improve clients' visits and experiences and FLWs' ability to deliver counseling messages. As part of the study in Tanzania, parents of ill children were interviewed after a clinician using the PDA-based precursor to CommCare (eIMCI) examined their child. The caretakers had positive views of the electronic system, and specifically noted that the system prompted providers to conduct more thorough examinations and ask more questions about their children [Mitchell, 2012]. A study in India found that FLWs' counseling techniques improved after five months of using CommCare. This included a 34% increase in FLWs who encouraged clients to use a health service, a 22% increase in FLWs who encouraged clients to ask questions or speak during visits, and a 25% increase in FLWs who waited for clients to respond to a question [Mohamed, 2014]

Accountability of Care

A crosscutting trend from the evidence base is that CommCare improves monitoring and communication. In one project in India, the introduction of CommCare improved data completeness from 67% with the paper-based system to an average of 84% with CommCare. CommCare also reduced the average time it took to submit data to a program coordinator from 45 days to 8 hours [Medhi, 2012]. A small pilot in Madagascar found that introducing CommCare reduced the time until data was made available [Ortiz, 2014]. In qualitative interviews, FLWs in Bihar and Uttar Pradesh, India, reported that community members felt greater social pressure to comply with recommended behaviors when they knew that their knowledge, attitudes, and practices were being recorded [Chittamuru, 2012].

Another promising aspect of mobile data capture is its ability to conduct real-time quality control (Figure 7). Research on CommCare has included

the development of algorithms to detect anomalous data from FLWs. After testing data generated by FLWs who were asked to submit false yet realistic data, the algorithms were able to identify the false data with 80% sensitivity and 90% specificity [Birnbaum, 2012].

CommCare has also been shown to improve form submission rates. A study in South Africa found that CommCare increased Healthcare Workers' (HCWs) submission rates of adverse event forms from 5% at baseline using paper forms to 27% using CommCare. The study also found a disconnection between HCWs' expressed enthusiasm for using CommCare and actual practice (which was lower than expected). The study concluded that programs should carefully explore FLW motivations and technologic enhancements prior to scaling new mobile health initiatives [Chijayachati, 2013].

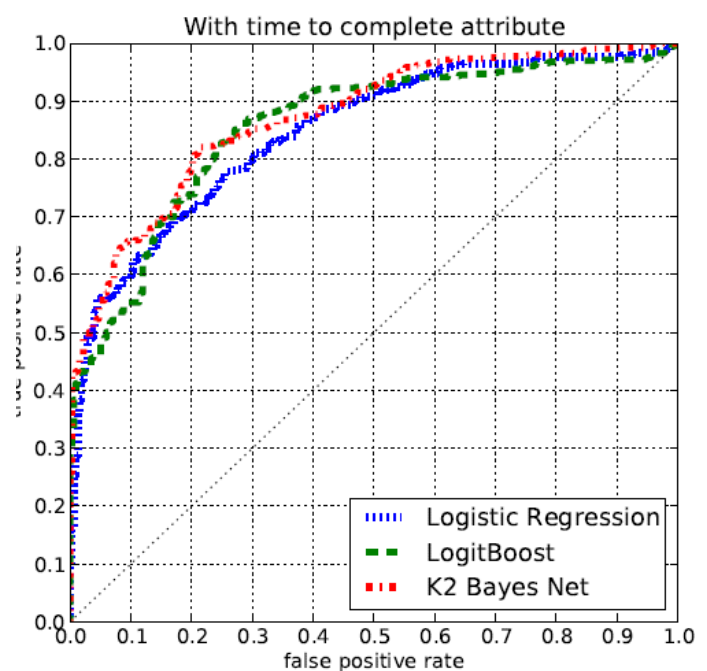


Figure 7. Algorithms used to support quality control analyze the distribution of answers by FLWs detect systematic errors and fake form submissions (Birnbaum, 2012)

Client Knowledge, Attitude, or Practice

There are a few examples in the literature where CommCare has helped improve client knowledge,

attitude, and/or practice. A study in India found that after interacting for five months with FLWs who used CommCare clients were 33% more likely to ask questions than when they interacted for five months with FLWs who didn't use CommCare [Mohamed, 2014]. CommCare was used in Zanzibar to increase the institutional delivery rates, especially in cases of complicated pregnancies. Traditional birth attendants (TBAs) were equipped with CommCare to identify danger signs, refer clients, record family members' permission to transport the women in case of emergencies, and facilitate payment to local vehicle owners to transport women to a facility. The intervention reported a 68% facility delivery rate, compared to the baseline of 40% and 23% recorded in the two control areas [ICT4CHW, 2011].

A world Vision study found that pregnant women in Mozambique who interacted with a CommCare pregnancy and postpartum module were more likely to know about pregnancy danger signs (20%) and seek facility care in case of complications. They were also more likely to be prepared for birth (64%) than in five similar studies where rates varied between 7% and 48%. Study results also indicated that there is an association between birth preparedness and referral completion rates (91% during prenatal period and 47% during postpartum period) [World Vision, 2012]. Another World Vision study in Afghanistan reported similar findings. In addition to being attributed to increasing the likelihood that woman receives antenatal care (20%) or has a skilled delivery (22.3%), CommCare was attributed to increasing pregnant women's knowledge of two or more pregnancy danger signs (12.9%), the likelihood that a pregnant woman would have a birth plan (12.6%), and the number of pregnant women who took iron supplements (14.4%) [World Vision, 2013].

In a study in Benin led by Center for Human Services (CHS), 264 clients in Benin received family planning counseling from a FLW with CommCare over four months. Of these women, 72 visited a health center to meet a health worker and 68 adopted a family planning method. While there

were no control group results to compare this adoption rate to, CHS noted that this was a significant increase than what CHWs are used to. They cite a testimonial from a midwife that demonstrates these results:

“Since the CHWs have begun this work with the phone [that uses CommCare], there has been greater demand for adopting family planning methods.” [Center for Human Services, 2013]

Research has also shown that CommCare not only impacts the knowledge, attitudes, and practices of clients, but of family members as well. A study in India of 50 FLWs found that family members of pregnant women—specifically their husband, sisters-in-law, and mothers-in-law—were more likely to sit in on CommCare-using FLWs' home visits with pregnant women than home visits where an FLW was not using CommCare, [Mohamed, 2014].

Alternative Systems

While there are many papers on mobile systems for community programs, we found few published papers on comparable mobile systems for use by FLWs (designed primarily for health workers) that have three critical properties for FLWs; **Client Tracking**, **Decision Support**, and **Multimedia**. The papers on alternative systems included in the evidence base show the general acceptability and feasibility of deploying mobile systems for FLWs, and their potential to facilitate other programmatic goals.

There are several systems with client tracking, decision-support, and multimedia included in the evidence base, including applications being deployed by D-tree International, Mobenzi, Mezzanine, Medic Mobile, Virtuosos, and eMocha. There are important differentiators among these

applications and CommCare, such as whether or not they are cloud products, which allow non-programmers to create and adapt the applications; the code is open source; and what types of phones are supported. These are key factors for scalability of applications. However, given the similarity of use case amongst these applications, the evidence on one is relevant to all applications using complex workflows with FLWs. For example, a paper published on Mobenzi Outreachers concluded that *“mobile phone-based information systems platforms offer significant opportunities to improve CHW-drive interventions.”* [Tomlinson, 2013].

The evidence base for eMocha is the strongest next to CommCare with several key papers published demonstrating evidence that supports the argument for the use of phones (smartphones) by FLWs. One paper published in 2011 conducted in multiple countries describes the potential for smartphone applications to empower healthcare workers, and the need for further evaluation [Bollinger, 2011]. A second study, published in 2012 outlined how eMocha facilitates a Home Based HIV Counseling and Testing program in Uganda [Tumwebaze, 2012].

Conclusion

Over the last ten years, Dimagi has participated in research initiatives for ICT platforms and healthcare delivery in under-served population around the world. In doing so, Dimagi has partnered with research firms, non-profit organizations, governments, and academic institutions to conduct research around the use of the CommCare platform. While many of the studies involved staff from Dimagi or D-tree International, the majority of these studies were led by academic researchers from outside organizations including the University of Pennsylvania, Nanyang Technological University, Microsoft Research, and the University of Washington.

The result is an extensive evidence base. There are 21 published papers about CommCare, compared

to three published papers on alternative systems. Available evidence about CommCare is further bolstered by important grey literature studies and five papers on closely related systems, including four that support PDA-based precursors to CommCare. These papers reflect what was available at the time of this literature review. The CommCare evidence base is updated periodically as more papers are published.

The collective findings from the 44 papers in the evidence base are encouraging. They demonstrate the potential for organizations to use CommCare to improve a wide range of aspects within their community program(s). The findings also support the hypothesis that CommCare can be used to increase the timeliness, accuracy, and relevance of essential information delivered to clients. However, it is important to note that CommCare by itself will not improve the behavior of FLWs, but can only amplify an organization's efforts to improve their community program. Organizations must continually support their FLWs and utilize the information delivered by CommCare in order to realize the potential benefits of introducing a mobile system to their FLWs.

Future Research

It is encouraging that there is preliminary evidence, in unpublished studies, that CommCare can create changes in client behavior, including knowledge, attitude, and practice. As we think about our next steps in expanding CommCare's evidence base, one area that we would like to further evaluate is CommCare's impact on clients' knowledge, attitude, and practice. We hope to also see rigorous studies demonstrating health benefits in the future, but acknowledge that these studies will be expensive and require extensive resources. These intermediate studies play an important role in providing insight into the potential benefit of CommCare and other mobile systems for FLWs, as well as guidance on how to improve CommCare to best reach its potential.

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