EXECUTIVE SUMMARY

This paper summarizes the evidence base for CommCare and closely related mobile health applications. We reviewed all published papers and unpublished (gray literature) studies about the CommCare platform, all published papers on pertinent, alternative mobile health systems, and several papers on highly relevant topics. This collection of 26 papers offers substantial evidence that CommCare improves access, quality, experience and accountability of care provided by community health workers.

SCOPE

This paper is an informal meta-analysis of published and gray literature available about CommCare and similar mobile health (mHealth) systems. CommCare is an open source mobile and web platform used by Community Health Workers (CHWs). CommCare replaces cumbersome paper registers, reporting forms, and patient education flipcharts with an open source, customizable software application that can run on a wide range of phones. CHWs register clients using customized electronic forms written in their native languages. During home visits, CommCare aids CHWs with real-time guidance on service delivery and referrals. CommCare applications include multimedia elements (audio, images, video) to assist low-literate CHWs and provide powerful educational content to be used with clients. Visits and encounters are logged and submitted in real-time to a central cloud server. Server-side software aggregates data and carries out automated performance analytics to identify strengths and weaknesses of individual CHWs, which enables more effective supervision and mentoring. A video demo of CommCare can be viewed online (http://tinyurl.com/commcarevideo). With over 5,000 registered mobile users across more than 25 countries, CommCare is one of the most widely adopted and technically advanced mobile platforms for CHWs. Three critical properties of CommCare are:

- **Client tracking**: CommCare allows CHWs to register and track their clients. A client list is maintained on the phone, as is a longitudinal record of information about each client.
- **Decision support during client sessions**: CommCare is designed to be used by a CHW during meetings with their clients, and to improve the quality of those interactions through electronic checklists as well as step-by-step guidance through clinical protocols.
- **Multimedia**: CommCare applications contain images, audio, and video. This makes the applications much easier to use by lower-literate CHWs, and provides a powerful behavior change communication aid when multimedia is shown to clients.

These are critical properties of CommCare, and thus applications that did not feature all three are not included in this review. For example, we are excluding pure data collection systems such as Open Data Kit or Magpi, as well as
any applications for CHWs that run on the most basic phones, including pure SMS applications for CHWs such as those developed on RapidSMS. While these applications bring their own set of advantages, they provide a fundamentally different value proposition and were considered separately.

The papers we included that are not about CommCare can be divided into two categories: related systems and alternative systems. Related papers 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 [DeRenzi2008, Mitchel2012], as well as research that examines how CHWs use video with clients [Ramachandran2010]. Alternative systems are currently supported by other organizations and share the critical properties described above. The alternative applications we examine in this paper are mobile applications developed by D-tree International, Medic Mobile, 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 currently no publications on the alternative systems they support.

Our selected evidence base includes papers within the following four categories:

- **Published CommCare**: All published papers about CommCare (excluding posters).
- **Unpublished CommCare**: Selected unpublished studies about CommCare, also known as gray literature. We selected studies based on our belief that they added particular value to the evidence base.
- **Published Alternative**: All published papers we found about mobile applications for CHWs that are considered to be alternatives to CommCare.
- **Published Related**: Selected published papers that are highly relevant to CommCare. These include a paper about a PDA-based precursor to CommCare, and research that focuses on engaging CHW clients with video.

Additionally, each paper was classified as being in one of the following levels of evidence:

- **Level 1, Conceptual**: Papers discuss the theoretical possibilities and justifications for CommCare, but aren’t tied to any particular intervention or system implementation.
- **Level 2, Implementation Narrative**: Papers describe the process and lessons learned from system implementation, with little or no rigorous evaluation.
- **Level 3, Qualitative interviews**: Papers describe qualitative interviews, most often involving CHWs using an mHealth tool.
- **Level 4, CHW Process Improvement**: Papers include quantitative changes to CHW processes or behavior, such as visit rates, data completeness, etc.
- **Level 5, Client KAP**: Papers present evidence that an mHealth system directly impacts client knowledge, attitude, or practice.
- **Level 6, Health Outcomes**: Papers present evidence that an mHealth system directly impacts client health outcomes.

The levels of evidence are organized by the paper’s rigor in addressing whether CommCare can improve client health outcomes.
THE EVIDENCE BASE

Table 1 below describes all of the papers included in the evidence base, and is organized by level of evidence. For each paper, we provide the following information:

- **Level**: Indicates the paper’s level of evidence (1-6), as outlined above.
- **Key**: Each paper was assigned a short reference code. This includes the leading author’s last name and date of publication. An asterisk is included if the paper is summarized in the appendix.
- **Highlights**: Provides a short summary of some key study findings.
- **Platform**: Indicates whether the paper focuses on CommCare or an alternative mHealth system.
- **Published**: Indicates if the selected paper has been published or is gray (not published). Posters are counted as gray literature.
- **Country**: Papers that describe work that took place in one or more countries are listed. “None” is written if the paper is not tied to a specific country. “Many” is listed if the paper describes work from more than three countries.
- **Year**: If published, the year of the publication. If gray, the year of the study.

### Table 1: CommCare Evidence Base

<table>
<thead>
<tr>
<th>Level</th>
<th>Key</th>
<th>Highlights</th>
<th>Platform</th>
<th>Published</th>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Braa2010</td>
<td>Presents flexible approach for utilizing DHIS2.0, OpenMRS, and CommCare together</td>
<td>CommCare</td>
<td>Published</td>
<td>Sierra Leone</td>
<td>2010</td>
</tr>
<tr>
<td>1</td>
<td>DeRenzi2011a*</td>
<td>Presents the case management framework</td>
<td>CommCare</td>
<td>Published</td>
<td>Unspecific</td>
<td>2011</td>
</tr>
<tr>
<td>1</td>
<td>DeRenzi2011b*</td>
<td>Outlines six key functions for mHealth</td>
<td>CommCare (&amp; others)</td>
<td>Published</td>
<td>Unspecific</td>
<td>2011</td>
</tr>
<tr>
<td>1</td>
<td>Routen2010*</td>
<td>Describes how to use CommCare to support family planning</td>
<td>CommCare</td>
<td>Published</td>
<td>Unspecific</td>
<td>2010</td>
</tr>
<tr>
<td>1</td>
<td>Bollinger2011</td>
<td>Describes potential for smart phone applications to empower health workers, and need for evaluation</td>
<td>eMocha</td>
<td>Published</td>
<td>Many</td>
<td>2011</td>
</tr>
<tr>
<td>2</td>
<td>Mangilima2010</td>
<td>Case study of CommCare in Tanzania</td>
<td>CommCare</td>
<td>Published</td>
<td>Tanzania</td>
<td>2010</td>
</tr>
<tr>
<td>2</td>
<td>Mhila2009*</td>
<td>Case study of CommCare in Tanzania</td>
<td>CommCare</td>
<td>Published</td>
<td>Tanzania</td>
<td>2009</td>
</tr>
<tr>
<td>2</td>
<td>Treatman2012a*</td>
<td>Case study of CommCare in India</td>
<td>CommCare</td>
<td>Published</td>
<td>India</td>
<td>2012</td>
</tr>
<tr>
<td>2</td>
<td>Bogan2009*</td>
<td>Overview of CommCare applications in Tanzania</td>
<td>CommCare</td>
<td>Published</td>
<td>Tanzania</td>
<td>2009</td>
</tr>
<tr>
<td>2</td>
<td>Schuttner2011*</td>
<td>Demonstrates that CommCare helped improve linkages between community and clinic</td>
<td>CommCare</td>
<td>Gray/Poster</td>
<td>Zambia</td>
<td>2011</td>
</tr>
<tr>
<td>2</td>
<td>Tumwebaze2012</td>
<td>eMocha facilitates a Household-Based HIV Counseling and Testing program</td>
<td>eMocha</td>
<td>Published</td>
<td>Uganda</td>
<td>2012</td>
</tr>
<tr>
<td>Page</td>
<td>Author</td>
<td>Study Details</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>---------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Bhavsar 2012</td>
<td>CHWs reported their clients were more attentive and trusted more the audio messages in the application</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guatemala</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Chittamuru 2012*</td>
<td>CommCare lent credibility to the message of CHWs. CommCare allowed CHWs to work around cultural and social barriers when discussing sensitive or taboo subjects.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Treatman 2012b*</td>
<td>Multimedia improves experience for clients and CHWs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Vijaykumar 2012</td>
<td>Use of CommCare improve CHW credibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mitchel 2012b</td>
<td>Electronic protocols well received by clinicians and clients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Related</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DeRenzi 2008*</td>
<td>Electronic guidance increased adherence to clinical protocols by ~20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Related</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ramachandran 2010</td>
<td>Videos on phones engage clients and their families</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Related</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Birnbaum 2012*</td>
<td>Algorithms can detect outliers, and identify CHWs who are submitting false forms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DeRenzi 2012*</td>
<td>Reminders and escalation to supervisor increased timeliness of visits by 85%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>IntraHealth 2012*</td>
<td>CHW knowledge of at least 3 of 5 danger signs improved from 48% to 70% after four months of using CommCare.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gray/Poste r</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Medhi 2012*</td>
<td>9 of 10 CHWs 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%.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Mitchel 2012a</td>
<td>Counselor using an electronic protocol can effectively screen HIV patients (i.e. task shifting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Related</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>South Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Mohamed 2013</td>
<td>CommCare increases the duration of client visits, and engages more decision makers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ollis 2012*</td>
<td>An intervention including CommCare improved institutional deliveries to 68% from a baseline of 40% or less</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CommCare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Of the 26 studies described in Table 1, eight were conducted in India and another eight were conducted in Tanzania. These are the two countries that Dimagi and D-tree International have most widely implemented CommCare. Fourteen of the studies were conducted or published in 2012. Table 2 shows a breakdown of the papers in Table 1 by evidence level and category. There are a total of 14 published papers on CommCare, 6 unpublished papers on CommCare, 2 papers on alternative systems, and 4 on related systems (3 of which are a PDA-based precursor to CommCare). Note that this review did not include unpublished studies on alternative or related systems to CommCare.

<table>
<thead>
<tr>
<th>Evidence Level</th>
<th># Published</th>
<th>#Unpublished</th>
<th># Published</th>
<th># Published</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual CommCare</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Implementation narratives</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Qualitative CHW interviews</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>CHW Process improvements</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Client KAP</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>26</td>
</tr>
</tbody>
</table>

**FINDINGS**

Although there is no definitive study showing an improvement in health outcomes from adopting CommCare, the collective evidence base shown in Table 1 makes a convincing case that, when used correctly, CommCare’s system can improve community health programs.

**Acceptability and Feasibility**

Several published case studies about CommCare provide clear evidence that the system is well received by CHWs and clients across different geographical regions and types of community health programs [Mhila2009, Bogan2009, Mangilima2010, Treatman2012a]. It is clear that CommCare can be introduced into CHW programs successfully, although a program’s ability to maintain enthusiasm for the mHealth system is a separate question. This is validated by several studies that have conducted qualitative interviews with CHWs using CommCare [Mhila2009, Bhavsar2012, Chittamuru2012, Treatman2012b, Vijaykumar2012] in Tanzania, India, and Guatemala. Overall, CHWs have reported that CommCare makes their job easier helps them gain more respect from clients.
While these results are partially biased due to the fact that interviewees typically want to speak favorably about CommCare, they are still highly encouraging.

**Access to Care**

We define access to care as how often and for how long a client meets with a CHW. Common barriers to access include high CHW turnover rates, CHWs not enrolling all eligible clients in their catchment areas, CHWs not conducting necessary visits after enrolling eligible clients, and CHWs spending limited time with clients during visits.

A randomized control study in Tanzania found that feedback generated from data collected by CommCare increased CHW visit frequency [DeRenzi2012]. The approach hinges on the fact that CHWs’ visits are reported in near real-time to a central server, CommCareHQ. CHWs 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 CHW visit timeliness by 86%, compared to CommCare-using CHWs who did not receive SMS reminders. CommCare has also been deployed in Zambia to help CHWs 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” [Schuttner2011].

A poll of 23 CHWs using CommCare and 17 not using CommCare in Kaushambi, Uttar Pradesh investigated how long CHWs spent with their clients and who attended the counseling sessions [Mohamed2013]. The results showed that sessions lead by CHWs 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 lead by CHWs that don’t use CommCare.

**Quality of Care**

We define quality of care in terms of whether a client receives complete and accurate information relevant to their health needs, and if their CHW makes the necessary assessments, treatment decisions, and referrals. Common barriers to delivering high quality care include a lack of training for new or replacement CHWs, CHWs failing to administer all counseling information due to sensitive topics or limited time, and inaccurate clinical assessments that are the result of measurement tools or a lack of motivation to act upon the assessment.

A prominent trend in this evidence base is that CommCare can supplement CHW training. A controlled trial in 2008 in Tanzania tested a PDA-based precursor to CommCare that contained an electronic version of the IMCI protocol for classifying and treating common causes of child mortality. 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 [DeRenzi2008].

The quality of care level a CHW provides is based on them knowing and being comfortable delivering correct information to clients. A study in India in 2012 showed that, after a period of four months of use, CHWs had increased their knowledge retention of at least three to five danger signs in all health categories from 48% at baseline to 70% [IntraHealth2012]. CHWs in India have self-reported better knowledge retention as a result of using CommCare, which has been helpful in presenting complex and sensitive topics [Chittamuru2012].

A study in Mozambique found that the use of a CommCare pregnancy and postpartum modules improves the quality of services delivered by CHVs, as demonstrated by higher danger sign identification and referral rates. Furthermore, CHVs reported enhanced communication with health facility personnel through the mobile phone,
which expedited the referral process. As a result of CommCare, the study found that surveyed pregnant women and mothers’ confidence in the provided services had increased as a result of CommCare [World Vision 2012].

**Experience of Care**
We define experience of care by a client’s level of engagement during a CHW visit and the degree to which the client finds their CHW persuasive. Common barriers to high experience of care include if a CHW doesn’t carry or misuses promotional materials and if they have low credibility in their community.

CommCare applications typically make extensive use of multimedia, especially images and audio clips that are recorded locally by native speakers. CommCare also support videos, though these are less common due to production expenses. The literature indicates that multimedia usage in CommCare increases client engagement [Treatman2012b]. These findings corroborate with earlier work that shows that videos played by CHWs on phones helped engage clients and other decision makers in the client’s family [Ramachandran2010].

Several studies have shown that CommCare improves CHWs’ personal credibility and the credibility of the health messages they deliver [Chittamuru2012, Vijaykumar2012, Bhavsar2012, Medhi2012]. These findings have emerged from qualitative interviews with CHWs, who have reported that CommCare has enhanced their credibility in the community and that their clients and clients’ families perceive recorded messages played on CommCare as more trustworthy. CommCare is widely viewed as an independent, objective source of information, which greatly benefits CHWs’ ability to deliver sensitive health information, such as information about family planning methods. In utilizing CommCare to communicate sensitive health messages, a CHW can act more as a trusted mediator in addressing the listeners’ questions and concerns about the phone’s messages. On the other hand, concerns are noted that use of CommCare to play health messages to the client can reduce interaction if the CHW simply plays the audio clips without initiating a follow-up discussion.

A study in Tanzania also reported that CommCare created a positive visit experience for clients. As part of the study, parents of ill children were interviewed after a clinician using a PDA-based precursor to CommCare (e-IMCI) 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 [Mitchel2012b].

**Accountability of Care**
We define accountability of care as providing more visibility into CHWs’ 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 near real-time reports about each interaction between a CHW and a client—with a level of detail and speed that is far beyond what even the best paper reporting systems could accomplish.

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 [Medhi2012]. In qualitative interviews, CHWs 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 [Chittamuru2012].
Another promising aspect of mobile data capture is its ability to conduct real-time quality control. Research on CommCare has included the development of algorithms to detect anomalous data from CHWs. After testing data generated by CHWs who were asked to submit false yet realistic data, the algorithms were able to identify the false data with 80% sensitivity and 90% specificity [Birnbaum2012].

**Client Knowledge, Attitude, or Practice**

There are a few examples in the literature where introducing CommCare helped improve client knowledge, attitudes, and/or practice. A World Vision study in Mozambique found that CHVs who used CommCare had a higher rate of birth preparedness (64%) than in five similar studies, where rates varied between 7% and 48% (World Vision 2012). This higher birth preparedness rate was associated with high recognition of pregnancy and postpartum danger signs (20%). 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).

CommCare was also used in Zanzibar to increase institutional delivery rates, especially in cases of complicated pregnancies. Traditional birth attendants 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 [Ollis2012].

**Alternative Systems**

While there are many papers on mHealth systems, we found few published papers on mHealth system for use by Community Health Workers that have the key properties described above of supporting client tracking, decision support during client sessions, and embedded multimedia. The papers on alternative systems in Table 1 reinforce the themes describes above, showing the general acceptability and feasibility of deploying mHealth systems for extension workers, and their potential to facilitate other programmatic goals.

There are several systems with client tracking, decision support, and multimedia 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 they are open source, have application builders which allow non-programmers to create and adapt the applications, and what types of phones are supported. However, given the similarities among these applications, the evidence on one is relevant to all of them, and as more papers emerge we will be including them as we update this document.

**Conclusion**

Over the last ten years, Dimagi has participated in research initiatives for ICT platforms and healthcare delivery in under-served populations, both domestically and abroad. We have partnered with research firms, non-profit organizations, governments, and academic institutions to conduct research about CommCare. While many of the studies involved people from Dimagi or D-tree, the majority of studies was led by academic researchers from organizations including University of Pennsylvania, Nanyang Technological University, Microsoft Research, and University of Washington.
The result is an extensive evidence base. There are 14 published papers about CommCare, compared to two published papers about alternative mobile health systems. Available evidence about CommCare is further bolstered by six important gray literature studies and four papers on closely related systems, including three that on a PDA-based precursor to CommCare. These papers reflect what was available at the time of this literature review, which was concluded in February of 2013. We will update this document periodically as more papers are published on CommCare and similar systems.

The collective findings from the 26 papers in Table 1 are encouraging. They demonstrate the potential for organizations to use CommCare to improve a wide range of aspects within their community health 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. It is, however, important to note that CommCare by itself will not improve the behavior of CHWs, but can only amplify an organization’s efforts to improve their community health program. Organizations must continually support their CHWs and utilize the information delivered by CommCare in order to realize the potential benefits of introducing an mHealth system for their CHWs.

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

References


Appendix: Summaries of Selected Papers

*Bhavsar et al. (2012)* Perceptions of Community Health Workers in Rural Guatemala Using a Mobile Application for Early Identification of High Risk Pregnancies.

**Project:** Guatemala; maternal health

**Category:** Qualitative interviews
Hypothesis: CommCare is a more effective platform than EpiSurveyor for case management by CHWs.

Key findings: Localized audio messages incited trust and influence. Data collection with CommCare was more effective than EpiSurveyor because patient data was always available on the phone and only required updates. CommCare’s usability results were also better than EpiSurveyor’s for this task.

Key challenges: This piece is a substantive poster, but lacks the full details of a report.

Project: Tanzania; maternal and neonatal health
Category: Improvements to health system process
Published/Gray: P
Rigor level: Medium
Hypothesis: Tools for automated data quality control make health systems more efficient and detect fabricated data better than in paper records, thus enhancing accountability.

Key findings: Active data management by health service providers makes it easier for them to respond to beneficiaries more quickly, monitor field workers more effectively, and follow-up with patients more easily.

Key challenges: The data management capabilities of CommCare are only useful in managing high-quality data and cannot detect unintentional fabrications that might result from lack of expertise, low training, high turnover, or mismatched incentives. Efforts to eradicate low-quality data could be successful, or could compound fabricators’ efforts.

Bogan et al. (2009) Improving Standards of Care with Mobile Applications in Tanzania.
Project: Tanzania
Category: Implementation narratives
Published/Gray: P
Rigor level: Medium
Hypothesis: There are multiple lessons gained from developing and testing CommCare in Tanzania.

Key findings: Initial findings show that the phone-based system is generally viewed positively by users and clients as more discreet and private than the paper-based system. Simplicity and flexibility are paramount aspects of the system. Participatory design was useful in anticipating problems.

Key challenges: Running out of battery, switching models of phone resulting in trust issues with community, most incorporated back into design process to improve system.

Project: Sierra Leone
Category: Conceptual
Published/Gray: P
Rigor level: Medium
Hypothesis:
Key findings:
Key challenges:

Chittamuru et al. (2012) CommCare: Evaluation of a Mobile Application for Maternal Health in Rural India.
Project: India; maternal health
**Category:** Qualitative interviews  
**Published/Gray:** P  
**Rigor level:** Medium  
**Hypothesis:** CommCare’s user-centered design is an effective tool for improving maternal health care service delivery.

**Key findings:** CommCare is perceived as credible and trustworthy by pregnant women and their families, is a useful tool when introducing sensitive/controversial topics, and often becomes the primary agent, while the CHW functions as a mediator between phone and beneficiary. The phone is engaging in that it facilitates communication and is inclusive of varied audiences, including husbands or mothers-in-law, and facilitates flexible audience size. CHWs feel they have better knowledge retention and enhanced social capital. Monitoring capacity of phone exerts social pressure on beneficiaries to comply with behavior change communication.

**Key challenges:** Trade-off between platform as a job-aid and as primary agent.

*DeRenzi et al. (2011a) A Framework for Case-based Community Health Information Systems.*

**Project:** Overview  
**Category:** Conceptual  
**Published/Gray:** P  
**Rigor level:** Medium  
**Hypothesis:** CommCare is a community health information system that has the potential to address critical gaps in healthcare service delivery.

**Key findings:** Flexible case management tools are applicable for a wide variety of community health programs. These tools support community health program effectiveness and reduce duplicated efforts.

**Key challenges:**

*DeRenzi et al. (2012a) Improving Community Health Worker Performance Through Automated SMS.*

**Project:** Tanzania; HIV management  
**Category:** Improvements to health system process  
**Published/Gray:** P  
**Rigor level:** Medium  
**Hypothesis:** SMS messaging capabilities enable CHWs to perform better by improving the regularity and timeliness of their visits, two critical elements to building trust with beneficiaries and delivering health services effectively.

**Key findings:** Escalating SMS reminders to CHWs and, when necessary, their supervisors makes CHWs’ performance more transparent and accountable. Regular visits can be important medically (e.g. neonatal check-up) and psychosocially (e.g. reducing stigma). Buy-in from CHWs in Tanzania was achieved in part because they were allowed to use phones for personal reasons.

**Key challenges:** Lack of two-way communication between health system and CHWs, in addition to supervisors’ limited ability to aggregate reminders.

*DeRenzi et al. (2011b) Mobile Phone Tools for Field-Based Health care Workers in Low-Income Countries.*

**Project:** Overview  
**Category:** Conceptual  
**Published/Gray:** P  
**Rigor level:** Medium  
**Hypothesis:** mHealth platforms’ effectiveness can be evaluated based on a six-point health function framework: data collection, training and access to reference material, facilitating communication among health workers,
providing job aids and decision support, supervision of health workers, and promoting healthy behaviors in the population.

**Key findings:** Inclusion of multimedia elements to reinforce each step in the forms, including audio, icons, or images, helps low-literate CHWs and turns the application into a powerful educational and behavior change communication tool that facilitates discussion.

**Key challenges:**

*Dimagi (2012) CommCare.*

*Project: Overview*  
*Category: Conceptual*  
*Published/Gray: G*  
*Rigor level: Low*  
*Hypothesis:* CommCare improves access to care, client engagement, quality of care and accountability of care.  
*Key findings:*  
*Key challenges:*  

*IntraHealth (2012) mSakhi: Putting Information into the Hands of Community Health Workers.*

*Project: Uttar Pradesh, India; maternal and neo-natal health*  
*Category: Qualitative interviews*  
*Published/Gray: ?*  
*Rigor level: Medium*  
*Hypothesis:* mSakhi is the most cost-effective and sustainable method of supplementing CHW training.  
*Key findings:* mSakhi was used to increase CHWs’ access to reliable information and as a tool for positive interpersonal communication with beneficiaries in support of broader CHW training under India’s National Rural Health Mission (NRHM). Participatory design yielded key adjustments prior to scale. CHW usage was high, knowledge retention increased, and CHWs reported gains in confidence and credibility.  
*Key challenges:*  

*Medhi et al. (2012) Combating rural child malnutrition through inexpensive mobile phones.*

*Project: Madhya Pradesh, India; child health*  
*Category: Improvements to health system process*  
*Published/Gray: P*  
*Rigor level: Medium*  
*Hypothesis:* CommCare improves data management by improving data quality, completeness, and timeliness, and is acceptable to users and beneficiaries.  
*Key findings:* CommCare cuts down the time it takes data to reach health system and improves data quality. Users are motivated by CommCare due to its ability to enhance social capital and ability to be used for non-work related activities (unlike single-use PDAs). CommCare accessibility was high, even for illiterate CHWs. Beneficiaries were engaged by phone’s ability to act as an extension of authority. Gains were made to health system process through active data management.  
*Key challenges:* Allowing for positive or non-harmful non-work related usage of the phone, e.g. taking pictures of malnourished children to hold other CHWs accountable, talking to friends, from problematic unsupervised use. Referenced ongoing transportation/portability issues, despite device’s robustness.

*Mhila et al. (2009) Using mobile applications for community-based social support for chronic patients.*

*Project: Tanzania; HIV management*  


Hypothesis: The initial stages of implementing CommCare yielded learning that can be used for product improvement.

Key findings: Make the product simple, in that all aspects of it are relevant and can be adjusted easily. Prioritize privacy when refining the product so that patient confidentiality is maintained. Partner with users in the design process and incorporate their feedback for optimal future use.

Key challenges: Charging the phone and training, re-training requirements for optimum usage.

Ollis 2012 Using mHealth for Safer Deliveries.

Project: Tanzania; institutional delivery

Hypothesis: Maternal deaths can be reduced by providing a safety net for women who would normally deliver at home through the use of technology, specifically by addressing the three delays in seeking care.

Key findings: The phone’s multi-faceted nature goes beyond presenting and recording information. It also includes having phone numbers of local vehicle owners available, recorded permissions from family, and the ability to call hospitals directly. Replacing traditional birth attendants’ financial incentives towards using this system. Improved traditional birth attendant knowledge levels and institutional delivery rates increased in target areas. In the pilot districts in Unguja and Pemba, the baseline facility delivery rate was 40% for North A and 23% for Pemba. Following a CommCare training, 25 TBAs registered nearly 700 women. 211 of those delivered, and 143 delivered at the facility, representing a facility delivery rate of 68%.

Key challenges:

Routen et al. (2010) Using Mobile Technology to Support Family Planning Counseling in the Community.

Project: Overview

Hypothesis: The Balanced Counseling Strategy can be used via an mHealth platform to increase access to and demand for family planning services.

Key findings:

Key challenges:

Schuttner et al. (2011) Use of mobile phone-guided community outreach for integrated primary health care and HIV services in Zambia.

Project: Tanzania; primary health and HIV management

Hypothesis: Providing CHWs with mobile phones improves service outreach, referral, and follow-up between clinic and community.

Key findings: Follow-ups facilitated through the mobile application resolved 91% of patients’ chief complaints, expanding access without necessitating clinic visits.
**Key challenges:** Clinic attendance following home visits can be improved; more work needs to go into identifying access barriers and optimizing clinical/operational entry points.

*Treatman et al. (2012a)* **Mobile phones for community health workers of Bihar empower adolescent girls.**

**Project:** Bihar, India; adolescent girl’s health

**Category:** Implementation narratives

**Published/Gray:** P

**Rigor level:** Low

**Hypothesis:** Communicating health messages through mobile phones can have an empowering effect on adolescent girls.

**Key findings:** Short, structured health messages delivered privately through mobile phones can positively impact adolescents’ knowledge and attitudes about their bodies and health, prompting them to pass information along to their peers.

**Key challenges:** No data in terms of how increased knowledge and positive attitudes influence practice, e.g. contraceptives uptake. This study highlights one girl and thus is an isolated example.

*Treatman et al. (2012b)* **Strengthening Community Health Systems with Localized Multimedia.**

**Project:** India

**Category:** Qualitative interviews

**Published/Gray:** P

**Rigor level:** medium

**Hypothesis:** The multimedia component of CommCare, in comparison to text-based ICTs, increases client engagement and enhances CHW credibility.

**Key findings:** Multimedia can improve CHW performance by improving adherence to processes, serving as a third-party agent in introducing sensitive and controversial topics, advocating for CHWs and enhancing their credibility, and improving engagement through attractiveness of platform. It is also sustainable and scalable.

**Key challenges:**

*World Vision (2012)* **Use of Mobile Phones for Improvement of MNCH Care: SCIENTIFIC REPORT.**

**Project:** Mozambique; pre-natal and post-partum care.

**Category:** Client KAP

**Published/Gray:** G

**Rigor level:** Medium

**Hypothesis:** To determine whether CommCare improves CHV performance in diagnosing and referring pregnancy complications, communicating with facilities during emergencies, and help pregnant/postpartum women access health services.

**Key findings:** CommCare usage was associated with an improvement in quality of services delivered, specifically regarding CHVs’ higher rate of danger sign recognition, a higher rate of birth preparedness compared to previous studies, and by association, a higher referral completion rate. CommCare also is associated with increased CHV credibility, strengthened linkages with the health facilities, and rapid mobile technology usage uptake.

**Key challenges:** Implementation challenges were related to mobile phones (finding suitable phones, recharging phones), participants (low literacy levels, phone misusage), limited supervision and M&E, and varying languages.

*DeRenzi et al. (2008)* **e-IMCI: improving pediatric health care in low-income countries.**

**Project:** Tanzania; child health

**Category:** Improvements to health system process
Published/Gray: P
Rigor level: Low

Hypothesis: e-IMCI unblocks barriers to compliance with the Integrated Management of Childhood Illness protocols, such as training expenses, insufficient supervision, time costs, and reduced rigor in protocol compliance.

Key findings: e-IMCI is an accessible tool for Tanzanian health workers that can reduce errors like unintentional deviations from IMCI. It is also acceptable to clinicians.

Key challenges: Balance between a fast and flexible system that simultaneously encourages protocol adherence; how to use the PDA to address other gaps other than protocol adherence.