Dimagi: Improving Maternal and Newborn Care

Through mobile technology, a social enterprise helps frontline service workers care for pregnant women and their newborns at the last mile in rural India

WORLD BANK GROUP

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Summary

India suffers from a high maternal and infant mortality rate, especially in rural areas, where poor women do not receive effective care and one in every 22 infants die within one year of life.

One of the main problems is the poor access, quality, and accountability of services provided by government Accredited Social Health Activists (ASHAs). There is delayed data collection and reporting; a lack of follow-up and compliance with visits; minimal coordination between ASHAs and nurse midwives; and no standardized delivery of counseling. The Indian government has not focused on building the capacities of ASHAs and has limited ways to monitor their performance.

In 2010, Dimagi, in partnership with Catholic Relief Services (CRS), IntraHealth International, Real Medicine Foundation, and Save the Children, deployed CommCare mobile technology to help ASHAs improve their care for pregnant women and their newborns at the last mile in rural India. CommCare is an open-source software application with mobile and cloud infrastructure that runs on inexpensive mobile phones.

CommCare uses audio, video, imagery, SMS texting, data and tracking forms, multiple languages, and other features to standardize ASHAs' service delivery, improve counseling techniques and patient coordination, and collect real-time data for performance monitoring. The multimedia aids enhance client engagement and assist low-literate ASHAs and their clients. CommCare electronic forms and database store information that would otherwise sit in thousands of paper notebooks with possibility of errors.

Today, over 4,000 ASHAs use CommCare (up from 2250 in 2015) in the health sector across 60 projects in India. These programs are currently spread across 17 states in India. Various qualitative studies have shown that CommCare has improved the quality of health services for pregnant women and newborns; timeliness of pre- and post-natal visits; data collection and monitoring; and ASHAs' accountability. Ongoing impact evaluations will provide more information in terms of the impact of CommCare on health outcomes.

Factors to consider when scaling up CommCare use by ASHAs include: integrating CommCare generated data with the government's Mother & Child Tracking System, which could also be used for performance monitoring of the ASHA program; using findings of qualitative studies and impact evaluations to build the business case for CommCare scale-up; moving from a grant-based to a revenue-based financial model to strengthen financial sustainability; and forging direct partnerships with state and national government.

Through a partnership with the Government of India and the Bill & Melinda Gates Foundation, a CommCare-based application is being scaled across eight Indian states to strengthen the monitoring of the service delivery of Anganwadi Centres in the country. The CommCare mobile application is intended to replace the extensive paper registers Anganwadi workers are required to maintain. The app is designed to improve the care Anganwadi workers provide their communities, tracking distribution of immunizations & supplementary food, attendance of children at preschool and the nutrition status of children up to age five. The scale-up is built off a pilot that was deployed to 500 Anganwadi workers in Bihar, India through a project with CARE. Currently 10,000 Angandwadis are using the system already and will be scaling to 25,000 in the near future.

Challenge

The status of mother and child health in India remains poor, as reflected in a high Maternal Mortality Rate (MMR) of 190 and a high Infant Mortality Rate (IMR) of 47 in 2012 (Figure 1). Just 52% of births are attended by skilled health staff (Figure 2). However, studies have shown that by moving deliveries from the home to the hospital, maternal mortality can be reduced by half. Further, indicators such as 49% of pregnant women not having three antenatal visits during pregnancy and only 47% of mothers receiving iron and folic acid for at least 100 days during pregnancy, point to health care service delivery failures.

Figure 1. Maternal and Infant Mortality Rate

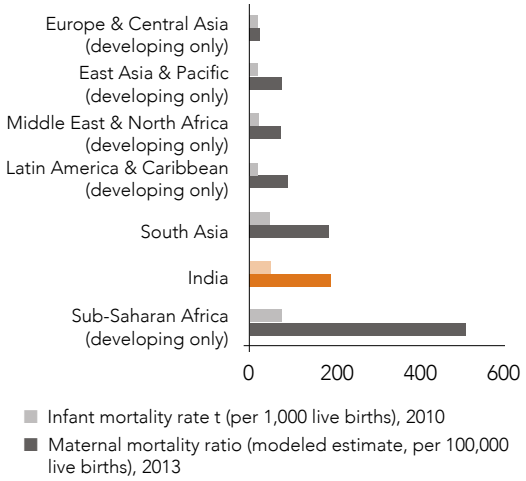
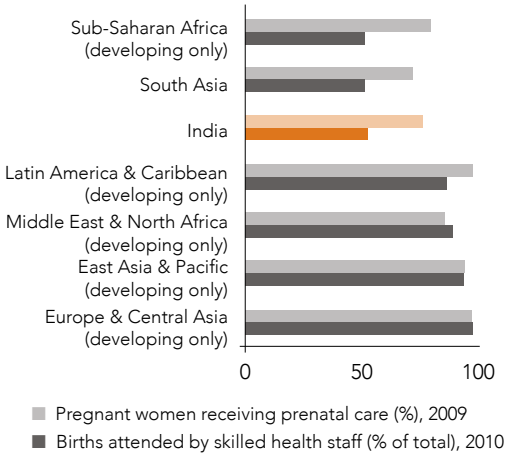


Figure 2. Prenatal Care



Source: World Bank, World Development Indicators.

In this context, the Government of India launched the National Rural Health Mission (NRHM) in 2005 to incentivize institutional delivery and the use of government health facilities in rural areas, and to provide services to underserved communities, including vaccinations, nutritional supplements, and family planning methods. NRHM aimed to establish a fully functional, community owned, decentralized health delivery system. To achieve this, NRHM appointed trained female community health activists per thousand populations—termed Accredited Social Health Activist (ASHA).

ASHAs are expected to visit clients' homes in their respective villages to promote health services and facilitate pediatric and prenatal visits to local facilities. The three criteria for becoming an ASHA are that she is a married, permanent resident of the village, preferably 25 to 45 years old, and literate with eight years of formal education. However, these requirements "may be relaxed if no suitable person with this qualification is available" (NRHM 2011). Since 2005, NRHM has deployed more than 750,000 ASHAs (Reddya and others 2012).

However, the ASHAs face a number of challenges in performing their jobs, including high workloads, insufficient training, poor credibility in the community, difficulty addressing sensitive topics with families, poor support for home visits, language barriers, and little or no feedback

about performance. They operate with minimal supervision, and do not properly collect and report data on patients and home visits (DeRenzi and others 2012; Baqui and others 2008; and Chittamuru and Bhavsar 2012). Improvements are needed to optimize ASHAs' health care delivery.

Innovation

Dimagi Organization

Since its inception in 2002 at Harvard and MIT Media Lab, Dimagi has been involved in the design, development, and implementation of adaptable mobile applications that strengthen health systems. Dimagi's mission is to deliver open and innovative technology to help underserved communities everywhere.

Dimagi is a privately held social enterprise headquartered in Cambridge, Massachusetts with offices in, in India, South Africa, Senegal, Guatemala, and additional staff based around the world. While Dimagi focuses on projects that span industries and technologies, the company got its start in healthcare and most projects still fall in this sector. Dimagi's 120-person team has experience working in both the developing and developed worlds, and across rural, urban, and tertiary settings in the United States, Africa, Latin America, and Asia.

CommCare: Mobile-based Software for Client Counseling and Management

Starting in 2010, Dimagi deployed CommCare, a mobile-based, cloud supported, open-source application that runs on inexpensive phones, to address the challenges of standardizing the delivery of services by ASHAs and improving their accountability (Figure 3). Instead of paper registers and flip charts, ASHAs easily track and support clients with registration forms, checklists, key counseling points using multimedia (images, audio, and videos), decision support, simple referral algorithms, and SMS reminders.

Highlights of the CommCare innovation include:

- **Case management:** ASHAs track multiple cases over time and promote timely, scheduled visits by sending SMS reminders. Real time data collected by ASHAs is stored on the central cloud server, CommCareHQ. The data is privacy-protected and provides access to health supervisors of ASHAs to assess each health worker's performance indicators, including daily activity, number of clients, length of visits, and follow-up rates.
- **Training and home visit support:** ASHAs use multimedia to enhance their engagement and credibility with clients, generating more demand for their services. Audio/visual aids improve adherence to protocols and audio prompts assist illiterate ASHAs. CommCare supports multiple languages, which mitigates distrust over local languages and dialects.

Figure 3. Features of CommCare

- **Data-driven monitoring:** ASHAs provide real-time data of their daily activities to supervisors, who track their performance and provide feedback to nurse midwives.

Dimagi trains the ASHAs on how to use CommCare and offers implementation support. They also offer customized service packages to implementation partners who support ASHAs.

CommCare Product Development and Rollout

In 2004, Dimagi began working with the Centre for Disease Control and Prevention in Zambia to design and develop SmartCare, a country-wide smart card based Electronic Health Record System. The system would track patient information across rural and urban clinics to improve continuity of care for the patients and providers, as well as strengthen the capacity of managing information on the country's health.

Dimagi's other consulting projects at the time also helped fund Dimagi's core operations. Over the years, Dimagi realized these disparate projects required creating custom solutions for each client that could limit Dimagi's prospects to scale. In addition, maintaining multiple software codebases during various stages of development for various clients and providing maintenance support with the same or diverse nature of problems across multiple clients was leading to duplication of work.

To overcome these challenges, Dimagi decided to develop a general version of a software platform product that would fit the needs of multiple clients. It used cases based on different configurations—a product approach—rather than creating unique solutions built from scratch for each client's project—a project approach. Under the product approach, Dimagi aimed at providing a turnkey solution to clients that would satisfy 90% of the functionalities required by the client (at a cheaper price). The product was designed to facilitate creation of multiple applications using a common codebase. This generalized product was named CommCare.

Dimagi's vision and goals for CommCare was threefold: (1) enable organizations to create and maintain Dimagi's product with minimal technical support; (2) make Dimagi's product widely accessible at a low cost; and (3) minimize duplication across projects.

In its infancy, the CommCare platform was used to create applications to serve as a data collection and reporting system on personal digital assistants (PDAs) for use by community health workers. Later, CommCare included tracking features that became a key differentiator in the product. PDAs were used early on because there was a perception that mobile phones could not perform complicated tasks. However, this notion faded after some experimenting by Dimagi on a few of its projects, and there was a shift shortly after to transfer the functionality from PDAs to mobile phones.

Figure 4. CommCare in India as of 2017

Financial Structure

Dimagi registered as a for-profit social enterprise under the Indian Companies Act of 1956. Although a for-profit enterprise, its financing mechanism since its establishment in India has largely been grant-based. In 2011, 95 percent of revenues were generated through grants (Figure 5). Grants from USAID (51 percent) and the Bill and Melinda Gates Foundation (14 percent) were the biggest contribution to the revenue stream. In 2010, Dimagi received grants from USAID-sponsored Development Innovation Ventures (DIV) to establish Proof of Concepts for the use of mobile applications in the delivery of basic services.

In the past few years revenue from sales has increased from 5 percent in 2011 to 28 percent in 2013 (Figure 6). These sales were generated from implementation partners such as CRS and World Vision using consulting services provided by Dimagi to support deployment (training of users and maintenance of CommCare). Dimagi also charges user hosting fees—approximately USD 2 per month/per user for any organization with more than 10 ASHAs using CommCare. The fee covers hosting, running and maintenance costs for the core software and servers. In 2016, sales (including bundles and services with partners and enterprise solutions for large scale projects has moved to 86% while product sales have grown to 7% (Figure 7).

Figure 5. Composition of Financing 2011

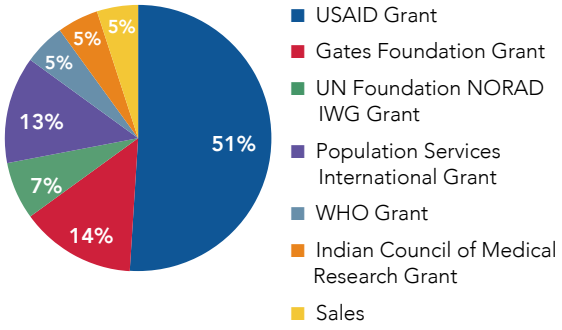


Figure 6. Composition of Financing 2013

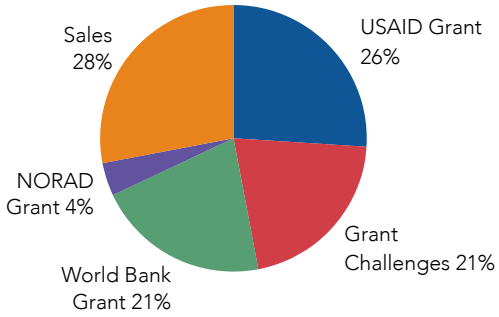
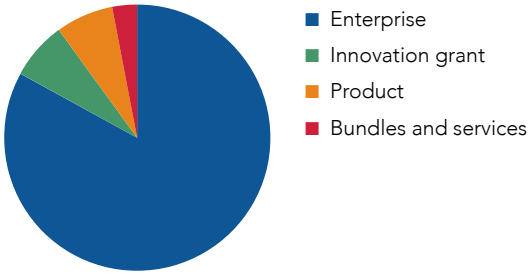


Figure 7. Composition of Financing 2016



Results Chain

Figure 8. Results Chain for CommCare Model

Inputs	Outputs	Outcomes	Development Goal
• **Financing:** largely grant-based • **Technology:** mobile-based, open source platform for ASHAs • **Manpower:** to assess demand, customize software, and support training and implementation • **Hardware/ equipment:** provide mobile phones to ASHAs to pilot use of CommCare	• Increased cases of institutional deliveries of babies • Enhanced pre- and post-natal care • Increased knowedge and improved counseling skills of ASHAs • Increased awareness of family members in maternal and newborn care	• Reduction of maternal mortality rate • Reduction of infant mortality rate	• Enhance health, life expectancy, and overall well-being for poorest populations

Implementation

Data Collection and Management

CommCare apps allow ASHAs to manage patients' files through a continuum of care in much the same way that a traditional doctor stores patient files on a computer. CommCare sends this collected data to a cloud-based server in real time, and it can also be used without mobile or Internet connectivity. Real-time data on patient health indicators and health worker performance provide clarity and insight into remote interactions, allowing for targeted service provision, enhanced quality of care, and constructive feedback to health workers. With CommCare, health workers are spending less time filling out paper forms, more time interacting with patients, making fewer data entry errors. Appendices IV–V provide examples.

Software Sales and Implementation Support

Dimagi has a Global Services team of solution architects, public health specialists, and experienced development professionals that work with organizations to deliver various implementation services. These services include everything from initial application design, development, field testing and iterations with users, and training and capacity building of all relevant stakeholders within an intervention. The services have the twin purpose of enabling the partners to manage local-level troubleshooting and customize the application as per the requirement.

More specifically, Dimagi offers five types of Implementation Bundles, a package of services, and 12 months of software plans (Figure 9). If the Implementation Bundle does not fit the needs of a partner organization, most of Dimagi's services can be accessed through a la carte offerings. A partner can select the software plan based on the required features and the size of its projects, add capacity services depending on their program and technology needs, and add performance plans according to longer-term support strategies.

Figure 9. Dimagi's Package of Services—Implementation Bundles

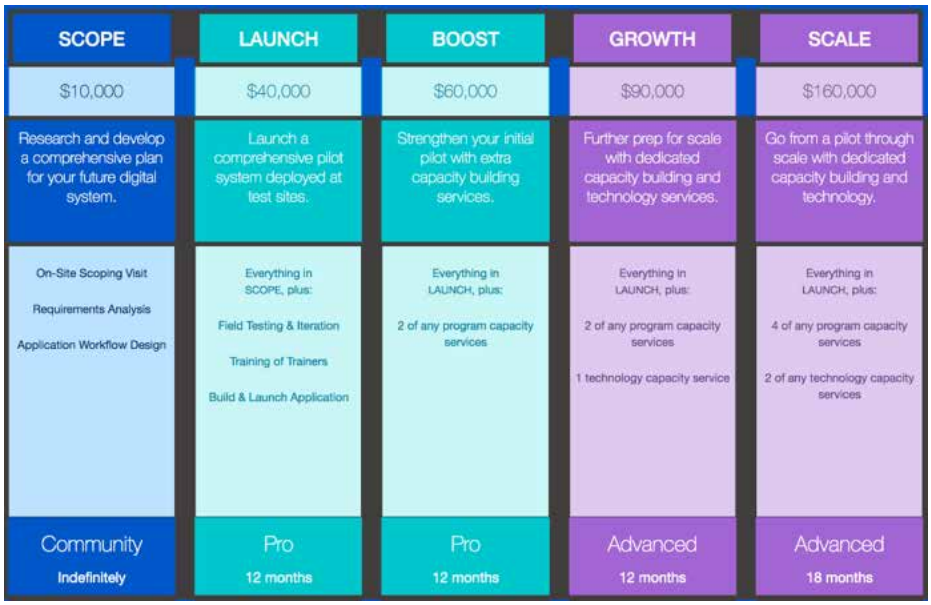
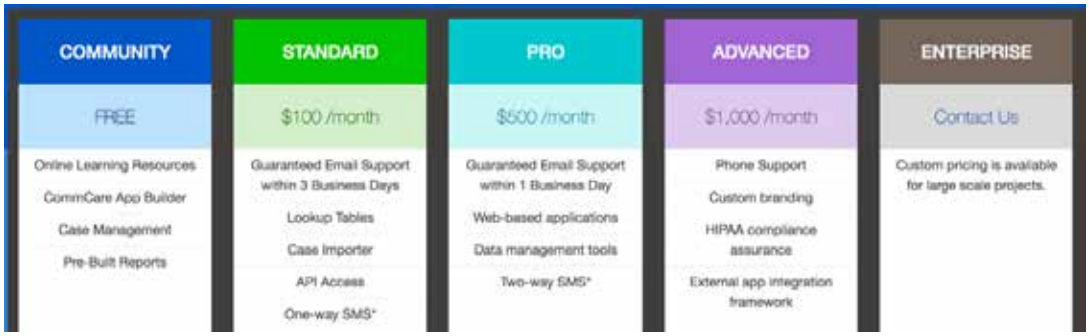


Figure 10. Software Plans



Customized Design

Through an iterative design process, Dimagi works alongside frontline health workers to design the application, which ensures mobile apps respond to the unique challenges that these workers need resolved. The interface is designed in an audio-visual format so that ASHAs with a lower literacy level can perform their functions effectively. The software includes registration forms, checklists, a tool for monitoring danger signs, and educational prompts with images and audio/video clips available in multiple languages. Appendices IV–V provide examples.

CommCare Exchange is an app store where organizations can share applications each has built using the CommCare platform to facilitate co-creation of mobile-based health application and easy download for reuse/customization. This app store provides cost-effective solutions and reduces duplication of efforts while building applications on CommCare.

Supply and Messaging Functionality

CommCare Supply is a logistics system which leverages mobile technology to strengthen supply chains in low-resource settings. Designed in close collaboration with health systems logistics experts from JSI and Ministries of Health, the technology has been tested and evolved through real-world deployments in Tanzania (ILSGateway), Ghana (Early Warning System), Malawi (cStock), and Senegal (cStock). All of these countries have now taken the system to national scale. Today, CommCare Supply is being used to improve quality of reliable, real-time stock information to decision-makers at all levels, streamline logistics systems with targeted alerts to supervisors and managers, facilitate early detection, resolution, and prevention of stockouts, reduce lead times through improved supervision of requisition and delivery, and improve resupply times for last-mile health workers.

CommCare Messaging allows organizations to build sophisticated messaging applications, tracking contacts over time and delivering customized and targeted messaging. It can also integrate with CommCare mobile phone applications and other tools built on top of CommCareHQ. CommCare Messaging can be used in a wide variety of workflows including communicating with patients in clinical trials, collecting infrequent information from farmers, sending out medication and appointment confirmations, SMS-based surveys or quizzes or simply as an information service.

Partnerships

Dimagi has fostered partnerships with three sets of partners:

- **Implementing partners:** NGOs such as CRS, IntraHealth International, Real Medicine Foundation, and Save the Children implement CommCare technology in the field. Dimagi provides technical expertise, capacity building, design support, and the technology platform at the outset of the project that the implementing partner then incorporates into its program.

- **Funding agencies:** Funding agencies provide financial assistance directly to Dimagi to promote and foster technological innovation in different geographical contexts. Core funding is provided by the Bill and Melinda Gates Foundation, International Development Research Centre (IDRC), UN Foundation, Norwegian Government, Rockefeller Foundation, USAID, and Vodaphone Foundation, Wellcome Trust. In 2013, the World Bank, through a Development Marketplace grant, enabled Dimagi to try a new innovative model of engagement—reaching scale in one state with one standardized application and directly engaging with the government.
- **Government:** Before the partnership with Development Marketplace, Dimagi's engagement with the Indian government at the state level (Bihar, Uttar Pradesh, Madhya Pradesh, etc.) was through the implementing partner NGOs. Through Development Marketplace, Dimagi directly engaged with the government for the first time through a block-wide state NRHM-approved pilot without the presence of an implementing partner. This gave Dimagi a chance to establish a relationship with the government and state-led development partners, and demonstrate the applicability of CommCare as a job aid.

Appendix VII describes the nature of Dimagi's partnerships and how the partnerships could evolve over the next 3–5 years.

Project Highlights

World Bank Development Marketplace—CommCare Scale-up in Jharkhand (June 2013–June 2015, World Bank, National Health Mission—Jharkhand): With support from the World Bank Development Marketplace, worked with UNICEF, USAID-MCHIP, and the National Health Mission of Jharkhand to test and scale a mobile job-aid for community health workers to track maternal and child health. Working with content experts, including UNICEF, Dimagi has developed and piloted a tool for ASHA workers to track pregnant women and newborn children through the continuum of care. Currently, the mobile tool is being used by 238 ASHA's in 1 high-priority district in Jharkhand, in partnership with local and district health officials. Dimagi is continuing to work with the National Health Mission to evaluate the ongoing pilot and the intervention has been included in the state's Project Implementation Plan for 2015 to scale to an additional 7 districts.

Ananya Project—MOTECH Suite Handset Application Development and Implementation (Jan 2013–Present, Bill and Melinda Gates Foundation, Multiple Partners): CommCare is being deployed by a consortium of 10 partners (including CARE, BBC WST and Grameen Foundation) as part of a five-year, statewide initiative with over $120 million from the Bill & Melinda Gates Foundation to improve health outcomes throughout the state of Bihar in India. While over 600 health workers are currently using CommCare, there is potential that the project will be scaled to all 60,000 health workers in the state. Through this effort that is in partnership with the Government of Bihar, CommCare and MOTECH are being integrated as part of a comprehensive mHealth platform that will be expanded to include other technologies such as OpenMRS. Partnered with the Grameen Foundation, Dimagi is integrating CommCare data with MOTECH such that a complete solution encompassing SMS, IVR, and Mobile Apps could be delivered across the entire set of partners in Bihar.

USAID Development Innovation Ventures Stage I and II—Scaling CommCare to Deliver Better Community Health to Millions throughout India (Sept 2012-Aug 2014, USAID, Multiple Partners): Dimagi completed USAID's Development Innovation Ventures (DIV) Fund Stage 1 Award in 2012 and Stage 2 to further scale up its work in 2014. Both DIV Fund Stage 1 and Stage 2 awards focused on scaling CommCare to over 50 organizations that support frontline worker (FLW) programs throughout India. By combining at scale an innovative, field-tested mHealth solution, a massive health workforce, a broad base of implementation partners,

and rigorous, relevant, and timely research, Dimagi worked towards realizing the full potential of community- based primary care as envisioned by the Government of India, and globally. Dimagi rapidly built the capacity of organizations to use mobile solutions across a number of sectors including health, finance, education, and agriculture, as well as rigorously evaluated the benefit of mobile solutions within the Accredited Social Health Activist (ASHA) program in India.

Catholic Relief Services ReMiND Project—Reducing Maternal and Newborn Deaths in India (June 2012–Sept 2015, CRS): In Uttar Pradesh, Dimagi has been working with Catholic Relief Services (CRS) to roll out pregnancy, postpartum, infant, and referral CommCare modules for FLWs in consultation with district and state health authorities. 400 FLWs are using audio and visual prompts to systematically counsel and assess women and babies for danger signs. FLW supervisors are also alerted when visits are missed. The CRS site has become a strong innovation test bed and an increasingly well-known example globally of mHealth as a supportive supervision tool. The project is currently assessing how direct-to-FLW feedback improves FLW motivation and performance. Preliminary results show that, after using CommCare for five months, ASHAs showed a 24% increase in knowledge of maternal and newborn interventions and a 34% increase in likelihood that they would encourage clients to use health services.

Over the last ten years, Dimagi has also participated in research initiatives for ICT platforms and healthcare delivery in under-served populations. Research (jointly conducted in partnership with University of Pennsylvania, Microsoft Research, and University of Washington) demonstrates the potential for organizations to use CommCare to improve their community programs, with an emphasis on monitoring and communication.

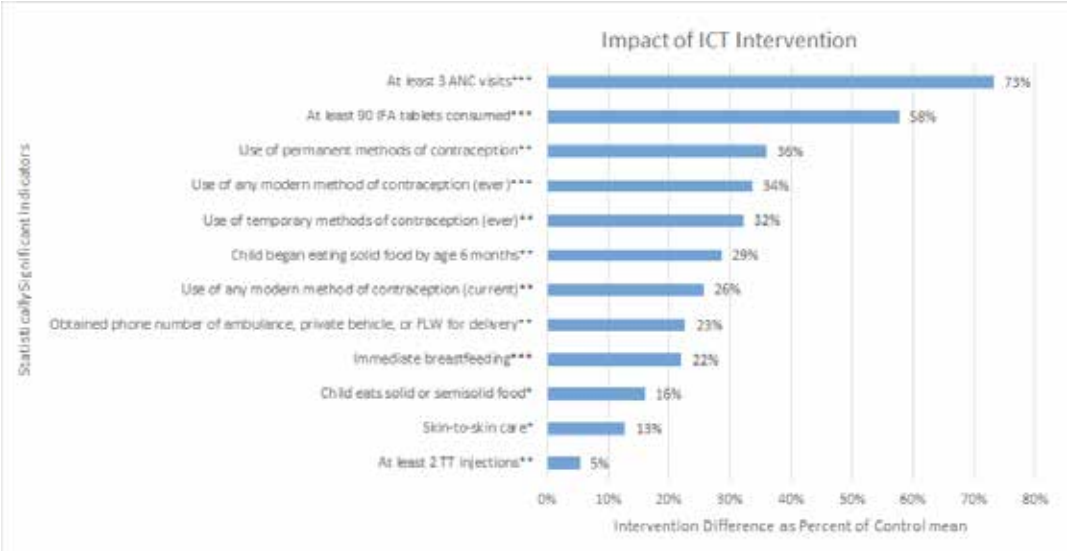
Impact

More than 50 studies explored CommCare's impact on frontline programs in low-resource settings.

Several published case studies on CommCare provide evidence that the system is well received by ASHAs and clients across different geographical regions and types of community programs (Mhila 2009; Bogan 2009; Mangilmam 2010; and Treatmen 2012). In India, qualitative research shows that CommCare technology is improving the quality of health, timeliness of visits, data collection, and ASHAs' accountability (Table 1). A study conducted by Mathematica Policy Research provides statistically significant evidence of substantive change in client behaviors from equipping FLWs with CommCare (Borkum, 2015). Another study found that an intervention using CommCare increased the average number of ANC sessions per woman by 41%, with 58% more women attending 3 or more ANC visits. It also doubled the number of FLW visits per woman.

Figure 11 presents the statistically significant improvements in ANC, child health, and family planning in the CommCare intervention group. Highlights include a 73% increase in women who attended at least three ANC visits, 58% increase in women who consumed 90 IFA tablets, and 36% increase in women using a permanent method of contraception as compared to the control (Borkum, 2015).

Figure 11. Impact of Intervention



Improved Quality of Counseling

A study in India found that frontline workers' counseling techniques improved after five months of using CommCare. This improvement included a 34 percent increase in frontline workers who encouraged clients to use a health service, a 22 percent increase in frontline workers who encouraged clients to ask questions or speak during visits, and a 25 percent increase in

frontline workers who waited for clients to respond to a question (Mohamed and others 2013). Mathematica, a third-party company, conducted a comprehensive evaluation of continuum of care services (CCS) in 2014. Preliminary analysis of the CommCare data illustrates the tool's positive effects, including an increased number of pregnant women registering at the early stage of pregnancy, correctly receiving 90 iron and folic acid tablets and accessing skilled care at birth. These early results also show a substantial leap in the percentage of women visited by a frontline worker within the first 24 hours of delivery from 6.7 percent to 59.5 percent in less than one year (CARE 2014).

Alongside Mathematica's current evaluation, Dimagi and CARE India conducted a short study to explore the impact of CCS on the quality and experience of care via observing a small number of ASHAs with their clients. The study also focused on whether different ASHA characteristics, such as literacy and education, affect ASHA adoption of the tool and the quality and experience of care directly. Among many findings, results indicate that higher levels of CommCare adoption are significantly associated with higher quality and experience of care.

For instance, the ASHAs who used CommCare most frequently scored 33.4 percent higher on visit quality and 24.7 percent higher on visit experience, compared to ASHAs who used CommCare least frequently (CARE 2014). Among other factors, the effect depended on how much ASHAs use audio, video, and images through CommCare during home visits. It also found that non-CommCare users often had short and incomplete visits, targeting care to the immediate state of mother and child, rather than to the full continuum of care. From these visits, CommCare appears to increase the comprehensiveness of home visits and instances of accurate counseling.

Job Aid for ASHAs

CommCare Evidence Base (Chatfield, et al, 2014) suggests that within a period of four months of usage of CommCare, its easy-to-use features have enabled health workers under CRS interventions to show a 22 percent increase in their knowledge on critical signs for the health of the mother and newborn. The enhanced knowledge among ASHAs on routine immunization, nutrition, and the health education needs for pregnant women is contributing to the social capital in the project locations.

The audio-visual counseling module embedded in CommCare has enhanced the knowledge base of ASHAs. An independent study found that compared knowledge retention of ASHAs for at least three to five critical signs across all key health categories before and after four months of deployment of CommCare. It highlights that ASHAs had increased their knowledge retention from 48 percent to 70 percent by using CommCare (IntraHealth 2012).

Using CommCare has also given ASHAs increased confidence in their job and respect from their clients. For example, in the case of ASHA Sunita of the village of Amra, pregnant women and their families are more respectful toward her, because she carries a mobile and uses it for structured counseling. For ASHA Lakshmi of the village of Bharasawan, the availability of content from CommCare has given her the confidence to provide structured counseling to pregnant women during home visits.

More Inclusive of Family

Quantitative studies and qualitative interviews confirm that CommCare attracts family members to counseling sessions. A study of 25 frontline workers using CommCare and 25 not using CommCare in Kaushambi, Uttar Pradesh investigated how long frontline workers spent with their clients and who attended the counseling sessions. The results showed that sessions led by frontline workers 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 frontline workers that don't use CommCare. Another study in India found that family members of pregnant women—specifically their husband, sisters-in-

law, and mothers-in-law—were more likely to sit in on home visits with CommCare (Mohamed and others 2013).

Improved Data and Case Management

CRITERIA	EVIDENCE
Reach/Access	• Availability—Number of ASHAs using CommCare increased: 100 in 2012 to 2,250 in 2013. • Access—Substantial leap in the percentage of women visited by a frontline workers within the first 24 hours of delivery from 6.7% to 59.5% in less than one year (CARE 2014).
Effectiveness	• More inclusive of family in care—Sessions lead by frontline workers 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. • Improved counseling techniques—One study showed a 34% increase in frontline workers who encouraged clients to use a health service, a 22% increase in frontline workers who encouraged clients to ask questions or speak during visits, and a 25% increase in frontline workers who waited for clients to respond to a question (Mohamed and others 2013). • Increased knowledge of care concepts—ASHA knowledge of at least 3 of 5 danger signs improved from 48% to 70% after four months of using CommCare (IntraHealth 2012). • Higher quality and experience of care—ASHAs who used CommCare most frequently scored 33.4% higher on visit quality and 24.7% higher on visit experience, compared to ASHAs who used CommCare less frequently (CARE 2014).
Accountability	• Increased data completeness, with 98% on-time delivery of data. • CommCare informs client counseling sessions, tracks clients, and helps ASHAs deliver appropriate information (Schwartz 2013). • Data completeness with CommCare is significantly higher at 84% compared to paper-based forms at 10% (Medhi and others 2012). • CommCare strengthens ASHA workflow by improving ASHA performance, improving the ASHA-beneficiary interaction, changing health norms in the community, and improving the monitoring of ASHAs within the health system (Flaming 2014). • Regular tracking of clients by ASHAs using mobile phones and sending SMS reminders to mothers/families regarding scheduled visits to health centers.
Cost-effectiveness and Affordability	• As an open-source product platform, CommCare's model can support development of scalable mServices that can demonstrate economies of scale by supporting multiple use cases, reuse of application workflows, and integration with national health information systems. This reduces costs for sustaining and scaling ICT solutions, enabling health systems to replicate multiple, integrated mHealth solutions rather than focus on investing in infrastructure and additional development for scaling a single project or use case.
Impact on Development Outcomes	• Preliminary analysis of CommCare data illustrate the mobile tool's positive effects on health, including an increased number of pregnant women registered at the early stage of pregnancy, correctly receiving dietary supplements, and accessing skilled care at birth. • Two ongoing impact evaluations are being conducted by CARE and Mathematica Policy Research, and Catholic Relief Services, Harvard Business School, and University of Washington, to provide information on impact of the deployment of CommCare technology on health outcomes.
Impact for Sustainability	• In 2011, 95% of Dimagi's revenues came from grants. In recent years, revenues from sales to partners have increased from 5% in 2011 to 28% in 2013 (NRMC 2014). • Dimagi plans to productize CommCare to increase sales revenue and financially sustainability.
Potential for Scalability	• The potential for scalability is high once Dimagi productizes CommCare and enters into direct partnerships with state and national governments through NRHM.

Sustainability and Scale-Up

Opportunities

Before the engagement in Jharkhand funded by a Development Marketplace grant, Dimagi had always worked with implementing partner NGOs, who would then in turn liaise with the government on any issues related to project implementation. Instead, Dimagi's engagement with the government was limited to sharing a platform as resource persons, such as during training of frontline workers or attending review meetings convened by the district health department.

Hence, Dimagi has created limited branding in its operational model of working through the partners and indirectly with the government. Further, where a given partner NGO (such as CRS) sub-contracts the field-level management to another local NGO with a grassroots presence, the possibility of engaging with government gets further constricted and so is the possibility for creating any major buy-ins from the government for replication and scale-up in the future.

For this reason and given the potential for scale-up, Dimagi is moving toward scaling-up the deployment of CommCare through a series of initiatives:

- Dimagi is planning to scale up the CommCare app with ASHAs across Jharkhand, thereby enforcing minimum standards of service delivery, maximizing the effectiveness of resources being deployed, and giving program managers access to timely, high-quality, and actionable information about current interventions.
- Dimagi's medium-term goal is to transition from the current user fee model (with NGOs as implementing partners) to a variant of the enterprise model in direct partnership with India's state and national government. Dimagi wants to arrive at a rate whereby the agreement could indicate that when any mobile project is launched by a given state government, then Dimagi comes in and supports them at a fixed fee for time and work.
- Another long-term possibility is active engagement with systems integrators (private companies such as TCS, Infosys, etc.) as a sub-contractor for training.
- Dimagi's long-term plan is to directly approach the state governments with the demonstrated ability to handle scale, without going through any system integrator. Dimagi has recently begun a pilot in Bihar (implemented through CARE) that bypasses a systems integrator to integrate the interactive voice responses with CommCare. Leveraging its partnership with other mobile health application developers, Dimagi plans to use the MOTECH Suite for undertaking the proposed integration for addressing core needs of mHealth. Upon success of the Bihar pilot, Dimagi would be able to demonstrate its capacity to handle scale and replication in other states.

Dimagi's revenue has grown in the past 10 years (+214% Compound Annual Growth Rate between 2010 and 2014), and has produced consistent small profit every year while investing in growth and expansion. In 2014, about 56 percent of Dimagi's expenses were covered through implementation services contracts, 4 percent through SaaS (Software as a Service offering), and the remaining 40 percent were covered from large direct grants to Dimagi. Globally, Dimagi has developed a plan to grow, accelerate its impact and become self-sustaining without innovation grants within five years (2020). To achieve this goal, Dimagi will accelerate

its customer acquisition, expand into new sectors, further invest in its technology and offer new value-added services.

Between 2015 and 2020, Dimagi expects to expand from about 200 to 1,500 organizations using CommCare and from about 20,000 to 180,000 users. They expect only 43 percent of the targeted customer base to be paying software fees. The other 57 percent will be able to access CommCare for free through pro-bono offering or through simple community subscription. Thanks to this growth, Dimagi expects to benefit over 100 million people within 10 years.

Factors to Consider Moving Forward

Partnerships

- Integrate CommCare data with government data. Since the CommCare application is embedded in public health care service provision and Dimagi is moving to scale-up CommCare, it is essential for Dimagi to proactively engage with the government to link CommCare data with the government's Mother and Child Tracking System. Data collected through CommCare is presently used by the program managers of NGOs for performance monitoring, and not by the government. Payment of incentives for ASHAs is based on Mother and Child Tracking System data, which is not integrated with the CommCare data.
- Facilitate scale-up through standard operating procedures and mechanisms for identifying partners. Dimagi selected partners under the USAID first round of funding on an ad hoc basis. For the second round of AID funding, Dimagi conducted a formal assessment of partners, which would need to be formalized before partners were signed. A due diligence process for identifying partners would ensure that future partners have the requisite technical and financial capabilities to effectively implement and sustain the partnership.
- Foster direct partnerships with state and national governments. By entering into agreements with state and national government through the NRHM and ASHA program, whereby Dimagi supports the deployment of CommCare at a fixed fee, Dimagi could increase the reach of CommCare technology manifold.

Human Resources

- Train personnel to supervise the deployment of CommCare. The availability of human resources that can provide technical support, supervise implementation and delivery of services, and help scale up operations is a key challenge. To address this long-term human resource challenge, the state governments are recruiting ASHA facilitators to supervise the work of 10–15 ASHAs. They need substantial capacity building and budgetary support to enable them to perform their tasks independently. In the interim, sector facilitators provided by NGOs supervise ASHAs on a daily basis. Once the NGOs' involvement is over, ASHA facilitators are expected to be hired by the government to provide necessary support. This challenge also provides a new opportunity for Dimagi to enter into the domain of skill development of trainers who can provide direct support to the government in supervision and monitoring of ASHAs.

Finances

- Move toward a revenue-based financial model. To make its model financially sustainable, Dimagi is moving toward productizing CommCare. Based on Dimagi's estimates, a base of 25,000 or more active users across all Commcare applications would help the organization sustain the cost and cover operating expenses. With a current user base of 2,250, it would require a significant jump for Dimagi to reach its sustainability targets in the near future (2–3 years). Dimagi claims it doubles its user base every year,

but without a direct sales or marketing team and with its continued reliance on grant proposals it is difficult to predict when the model would become financially sustainable.

Research and Advocacy

- Build an evidence base on CommCare benefits. Working directly with the government requires evidence in terms of cost-efficiency and the associated benefits of using CommCare, along with its positive impact on improving health outcomes. For instance, even after three years of intervention in the Kaushambi district, there is no budgetary support in District Plans for piloting/rolling out of CommCare. Until an evidence base is created, Dimagi's engagement with the government and scaling up of operations would be constrained. Two independent impact evaluations underway could generate the government confidence needed before any full-scale integration is considered.

Lessons Learned

Use technology and multimedia to enable service delivery

The Dimagi model demonstrates how technology-based solutions have the potential to scale access of health services in a cost-effective manner, standardize delivery of services at the last mile, and improve the accountability of field-level workers.

Use multimedia to improve client engagement

Multimedia aids—such as video/audio clips, images, checklists, and educational prompts—can enhance engagement with clients, quality of counseling, and frontline workers' knowledge and skills. Multimedia is also useful for low-literate groups, by emphasizing visual/auditory cues over text.

Integrate collected data from non-state partners with government data

It is essential for players such as Dimagi and social enterprises to proactively engage with the Indian government to develop a common understanding around data collection and monitoring. Initiating collaborative efforts toward data collection, reporting, and data management of pilot data and beyond could significantly enhance the core of funding and support for subsequent pilots.

Involve family members in care

Being more inclusive of the client's family members in home visits and general health care—such as husband, mother, and in-laws—creates a circle of trust and a tight support system that can prove critical during pre- and post-natal care. Audio recorded in the local dialect and clearly designed images can attract the attention of key decision-makers, such as the mother-in-law.

Create an evidence base for advocacy

Social enterprises should collaborate with research institutions to conduct qualitative studies and robust impact evaluation to build the evidence base on the impact of interventions on development outcomes. This evidence would inform government and development institutions on future development strategies, including resource allocation.

APPENDIX I

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This case study was developed through an analysis of qualitative and quantitative studies, desk review, organizational-level data analysis, and local consultations.

APPENDIX II

Dimagi Products and Services

Products Offered

- CommCare: CommCare is an easily customizable mobile platform for frontline workers to track and support their interactions with clients.
- CommTrack: A tool for mobile logistics and supply chain management.
- CommConnect: A solution for building SMS applications allowing for two-way messaging, conditional reminders, surveys and broadcast messages.

Services Offered

Dimagi offers services in technology strategy, software engineering, and training. The primary focus is public health in the developing world, with expertise in mobile health solutions.

1. Software Development

Software development expertise in a variety of capacities:

- End to end development
- Engineering program management
- Core development
- Technical and logistical support
- Deployment strategy

Experience in a variety of application domains

- Nationwide medical record system using smartcards and offline synchronization
- SMS-based emergency disease outbreak surveillance, data aggregation, and reporting
- Mobile and SMS-based inventory tracking and supply chain management, from small warehouses to nationwide antimalarial bednet distributions
- Interactive Voice Response (IVR) systems for health education awareness
- Distributed data collection and transformation for statistical analysis

Experience in development on unique, limited platforms

- Extensible mobile development, including cell phones, PDAs and SmartPhones
- Proven capabilities in developing high-quality software on low-cost platforms
- Experience designing distributed systems with limited network access

Experience in diverse types of team environments

- Single person or small team rapid prototyping
- Multi-country, multi-person development
- Collaboration among single independent contributors to an open source community
- Large open source development
- Creating productive teams with members with a wide range in technical skill levels

2. Technology Strategy

Example strategic services include:

- System architecture and design
- Data warehousing and analytics
- Project planning and management
- Team building, agile planning, and training
- Due diligence (for new or existing projects)
- Technology evaluation and selection
- Harmonizing technical implementation with budgetary constraints
- Integration with existing infrastructure and legacy systems

3. Technology in Health Care

Dimagi provides specialized health care informatics consulting services to commercial, academic and government organizations worldwide.

Understanding of health care provider domain

- Clinical, financial, and billing data
- Electronic medical records and decision support
- Requirements and feasibility analysis in clinical settings
- Years of experience designing front ends for both low resource and high end customers

Experience with health care data standards

- Security and Privacy (HIPAA)
- Controlled vocabularies (SNOMED, ICD, CPT)
- Health Information Exchanges (HIE)

Experience with advanced medical informatics

- Medical artificial intelligence and machine learning
- Data visualization and modeling
- Bioinformatics
- Imaging and Radiology

4. Technology as a Teaching Tool

Experience deploying creative solutions

- Distance learning courses
- Mobile phone based health education curriculum with airtime incentives
- Literacy retention by means of SMS distributions

5. Training

Dimagi provides design and support for effective technical training plans for teams of various technical skill levels.

Training expertise

- Years of in-country support and training time in South Asia, Africa, and other regions
- Remote assistance, training, and troubleshooting on multiple off-site projects
- Experience working with a variety of diverse projects and teams

APPENDIX III

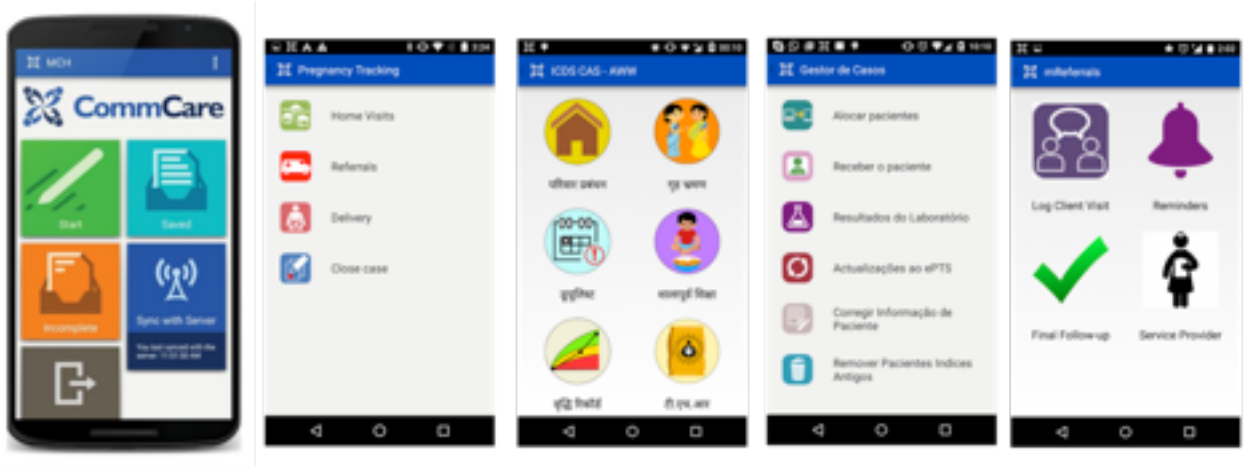
Users and Supporters of CommCare

Hundreds of organizations actively use CommCare, ranging from pilot projects to national deployments. Dimagi is working on more than 500 projects in over 60 countries today. Our partners include: Bill & Melinda Gates Foundation, USAID, World Vision, and more. For more information, check out the Dimagi's Partner site: http://www.dimagi.com/partners/.

APPENDIX IV

Screen Images of CommCare

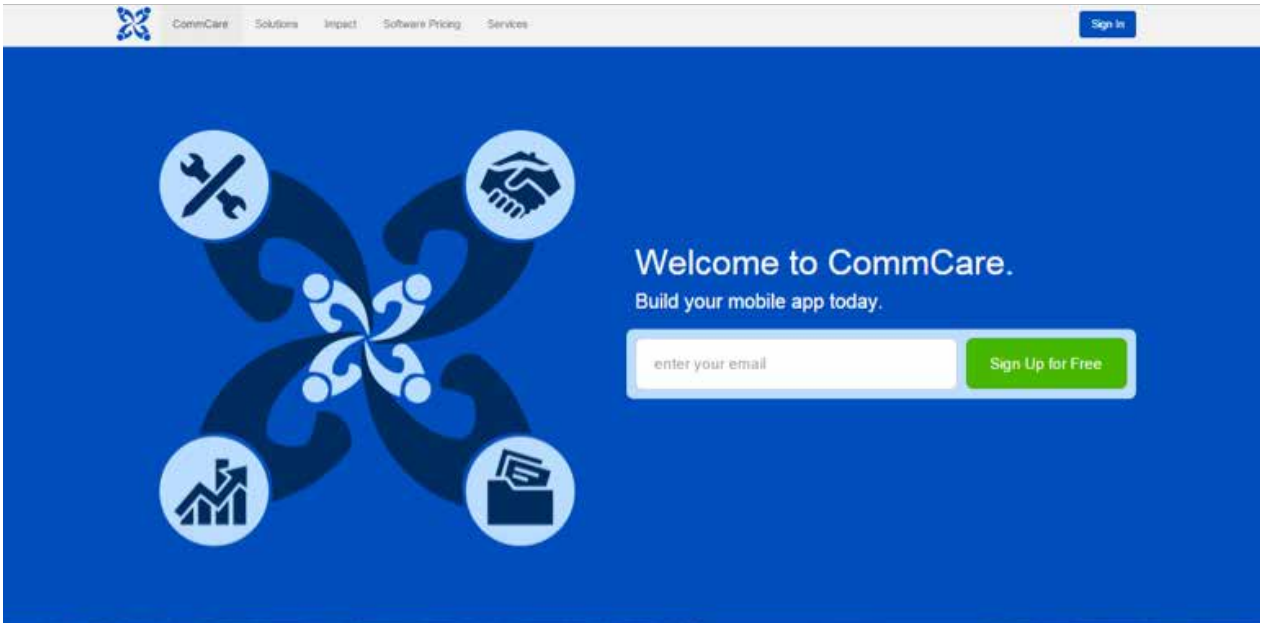
Example screens of a CommCare appp on Android interface.



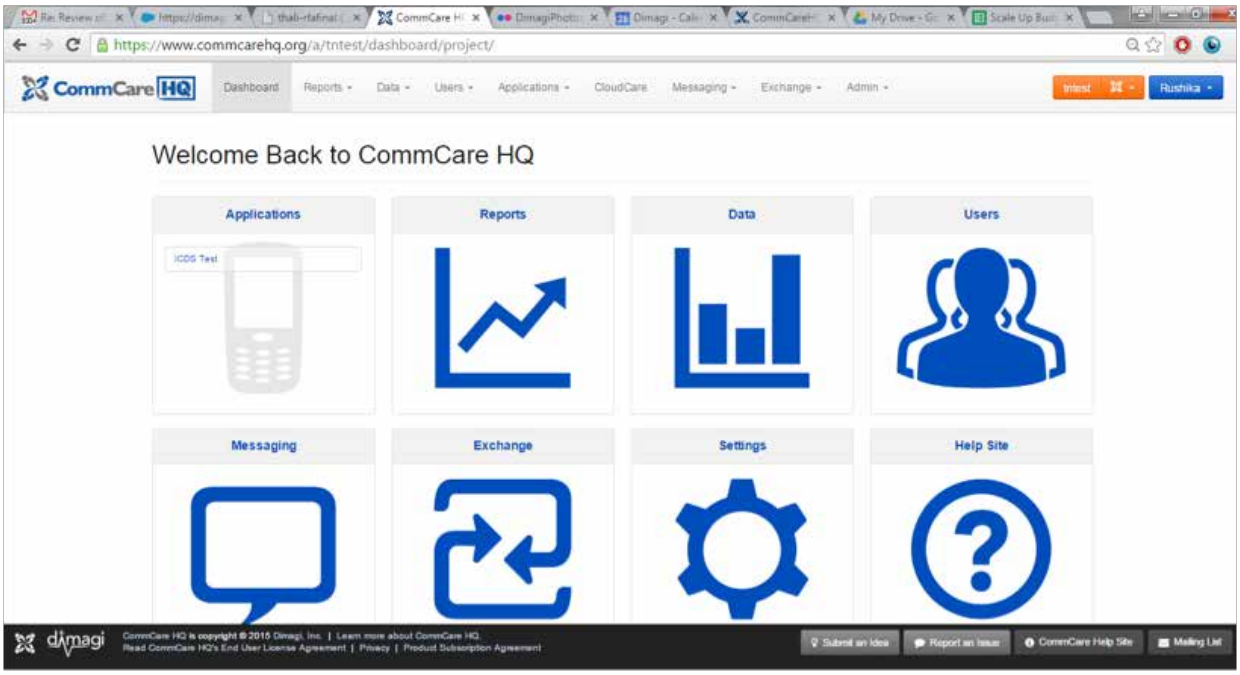
APPENDIX V

Images of Mobile Data Collection and Storage

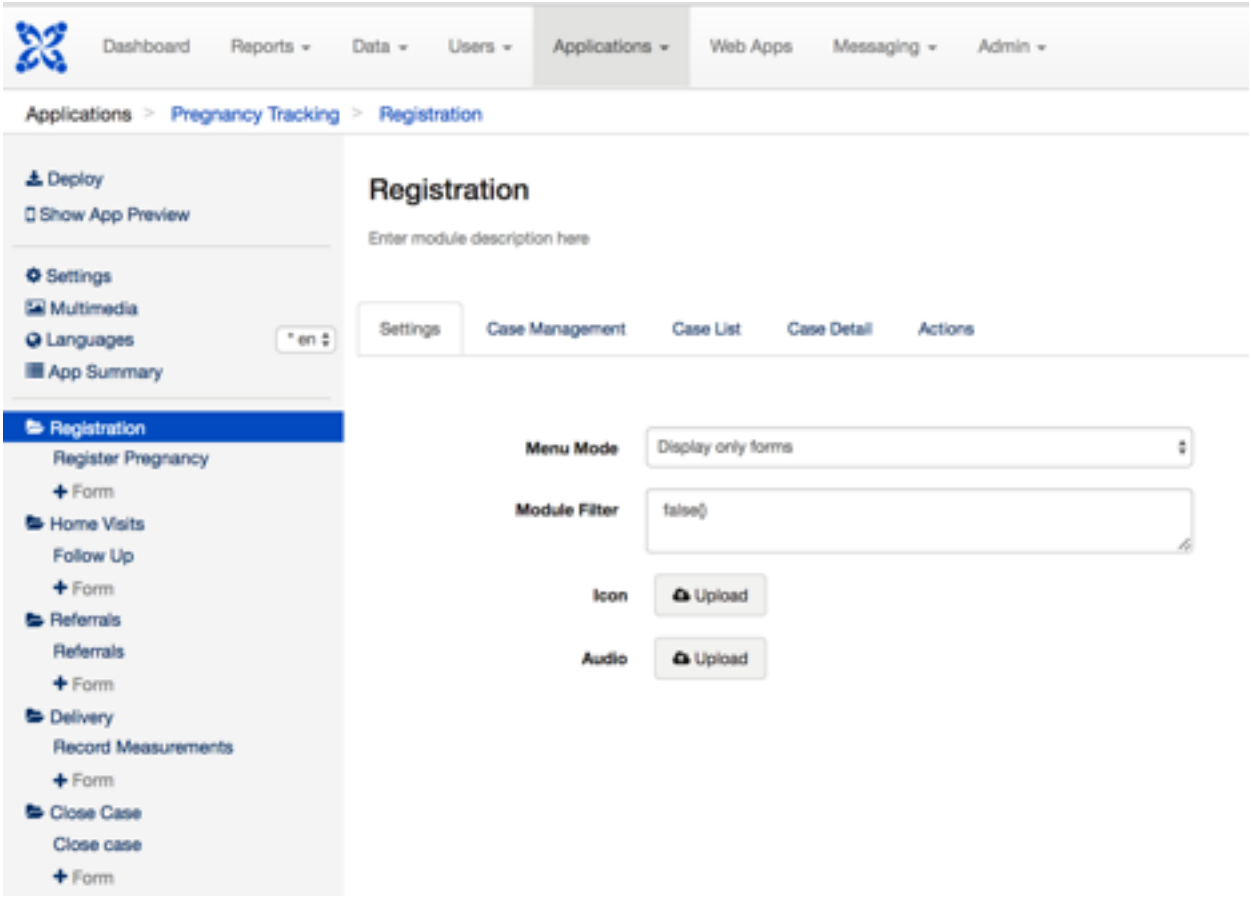
CommCare sends data over standard phone networks for inspection on the web in real-time..



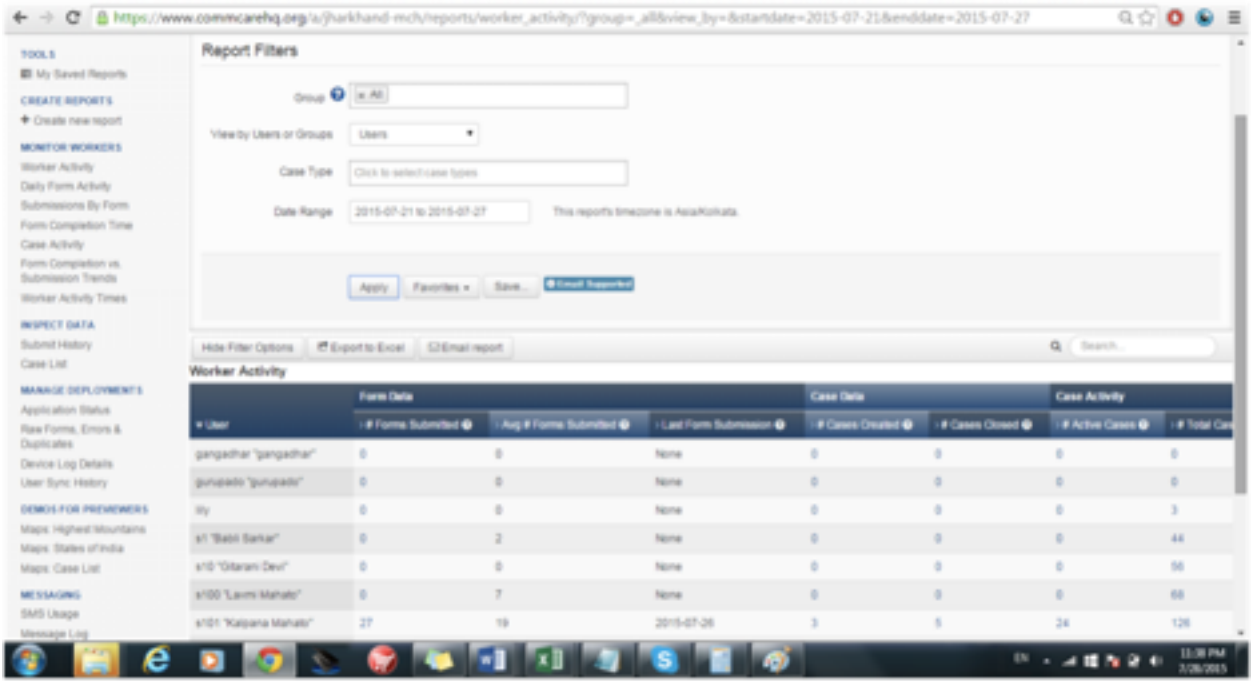
User Configurable Platform – Anyone can Create a Free Account



User Configurable Application Builder (No Software Coding Required)



Daily Reports



APPENDIX VI

Partners of Dimagi and Geographic Distribution

State	Partners	Project Focus	Description of Partnership
Tamil Nadu	ICTPH (IKP Centre for Technologies in Public Health)	Risk Assessment	CommCare case management tool deployed with 10 CHWs in Sep 2011. Steadily expanding its models to additional areas.
	PHFI (Public Health Foundation of India)	Chronic Care	Wellcome Trust funded 3-year large-scale study of CommCare to reduce key risk factors and treat chronic illness including hypertension and diabetes. Grant awarded. This project is taking place in Karnataka and Haryana.
Rajasthan	Save the Children, HP	Maternal and Child Health	CommCare case management tool deployed with 10 ASHAs in May 2011. Obtained funding from HP and phones from Nokia to scale and evaluate with 70 ASHAs from Jan 2012 to Sep 2012.
Uttar Pradesh	CRS (Catholic Relief Services)	Maternal and Child Health	CommCare case management tool deployed with 10 ASHAs in April 2011. Expanded to 110 ASHAs in September 2012. Funded to scale to another 140 ASHAs in a neighboring district by June 2013. Strong involvement from District CMO, large RCT on performance motivation underway.
	IntraHealth	Maternal and Child Health	CommCare training application deployed with 10 ASHAs in March 2011. Part of demonstration project with statewide scale potential. Was Phase I of mSakhi.
	Harvard School of Public Health	Maternal and Child Health	Maternal and child surveillance for Gates-funded study of a Better Births checklist requiring 170,000 births to be monitored. Pilot started in November 2012. Planned start to the study in May 2013.

State	Partners	Project Focus	Description of Partnership
Maharashtra	IL&FS Education and Technology Services	AIDS	Technical investigation for a mobile health system for community health workers in partnership with local NGOs and the Maharasthra State AIDS Control Society. Developed technical requirements for mobile system; three-week duration in August 2010.
	World Vision	Maternal and Child Health	CommCare case management tool deployed with 10 ASHAs in July 2011. Scaled to 40 ASHAs in July 2012. Attempting further scale across six sites with expectation of government uptake if successful.
	PATH	Tracking Pregnant Woman	CommCare project Navi Mumbai slum from April 2012 to August 2012 to track pregnant mothers by 15 LINK workers.
	SNEHA NGO	Maternal and Child Health	CommCare Android application focused on reducing malnutrition in 18,000 households in Dharavi, Mumbai from March 2012. Scaled to another 30 workers in June 2012.
Gujarat	JSI (John Snow, Inc.)/MI	Oral Rehydration Salts (ORS) and Zinc Tracking	Assess implementation of CommTrack to track ORS and zinc and support the current supply chain for ASHAs, AWWs and ANMs.
West Bengal	Durbar/UCLA (University of California, Los Angeles)	HIV Medicine Adherence	CommCare Android application combined with Interactive Voice Messaging to deliver voice-based health and appointment messages daily to improve adherence to medicine for HIV positive people in Kolkata as part of RCT with UCLA.
Delhi	PHFI(Public Health Foundation of India)/IIPHD (Indian Institute of Public Health)	Survey Tool	CommCare Android application used to survey 16,000 households to evaluate the effectiveness of the new cadre of urban health workers throughout Delhi.
Various: Chhattisgarh, Rajasthan, Orissa, Assam, Gujarat, Maharashtra, West Bengal	PSI (Population Services International)	ORS and Zinc Tracking	Implementing CommTrack and CommCare to manage ORS and zinc supply chain at approximately 20,000 shops across the country. Salespersons will use CommTrack to report stock and sales of ORS and zinc at various sales outlets. CommCare and CloudCare will be used to track progress of training and outreach sessions. Pilot began in November 2012. Scale up in December 2012.

APPENDIX VII

Role of Partners and Evolution of Partnerships

		EVOLUTION		
Type	**Role**	**Inception (0-2 years)**	**Current (2-3 years)**	**Plan for future (3-5 years)**
Implementer • Partner NGOs (CRS in Uttar Pradesh). • Grassroots NGOs (Vatsalya in UP).	• Receiving funds for implementation from Dimagi (from DIV 1 and 2 funding) for Proof of Concepts. • Local liaison and MoU with district administration for project implementation. • Liaison with state government for possible replication. • Identifying and training grassroots NGOs for field implementation. • Enabling training of in-house IT team for field deployment of CommCare. • Interface between beneficiaries, communities, grassroots NGOs, government and Dimagi.	• Number of Partners: 10 identified partners undertook pilots with funding from DIV 1 for establishing Proof of Concepts through 100 CommCare users. • Partner selection: Adhoc • Role: Organize training for frontline workers, cluster coordinators and in-house IT team on use of CommCare (Dimagi's staff as resource persons); regular monitoring. • Payment: No fee charged from partner NGOs during the inception phase.	• Number of Partners: 40 identified for undertaking pilots under funding from DIV 2 (2,500 users). • Partner selection: through call for proposals from Dimagi. • Role: ○ Earlier role continues; Handholding support to cluster coordinators for minor troubleshooting in the use of CommCare. ○ Training of in-house field managers of partner NGOs on interpreting reports generated by CommCare. ○ Advanced capacity building of in-house IT team for managing 90% of the troubles faced by Frontline workers in using CommCare. • Payment: Partner NGOs (not grassroots NGOs) pay user fee, hosting fee and management and technical support fee to Dimagi.	• Partner selection: call for proposals; due diligence of partners' capacity recommended. • Role: ○ Continue implementation; ○ Smaller partners availing of CommCare exchange for accessing suitable applications (free of cost till 50 users). • Payment: Pay to Dimagi the user fee, hosting fee, training and technical support fee.

		EVOLUTION		
Type	**Role**	**Inception (0-2 years)**	**Current (2-3 years)**	**Plan for future (3-5 years)**
Government • State/ District/ Block level government functionaries.	• Concurrence to implementers for the project in select areas. • Stakeholder in using CommCare data for performance monitoring of ASHAs. • Enabling programmatic linkage with NRHM. • Stakeholder in reviewing project progress and impact of CommCare in reducing MMR.	• Partner NGOs (such as CRS) and grassroots NGOs interacted with the district and block functionaries. • District health department provided necessary concurrence for the project; nominated ASHAs for training on CommCare.	• Partnership with district NRHM continues. • Partnership with state governments for scale up. Direct interaction between Dimagi and the state government.	• State government buys into the scientific evidence created on the benefits of use of CommCare (e.g., evidence on reduction in MMR and increase in institutional delivery). • State governments replicate and upscale use of CommCare in the state. • State government provides the platform to Dimagi for finalizing content for CommCare and rollout across state; avoiding duplication of enabling platforms. • MoUs with state governments for partnership for any mobile projects of the governmentt; payment terms on agreed rates.
Donors • International id and Development Agencies: World Bank, IFC, USAID, etc. • Special Grants: Development Marketplace of the World Bank; DIV 1 and 2 of USAID.	• USAID funding support to Dimagi under DIV 1 and 2 for establishing Proof of Concepts. • Development Marketplace grant for Dimagi for upscaling the Proof of Concepts in Jharkhand.	• DIV 1 funding for establishing 10 Proof of Concepts.	• DIV 2 funding for establishing additional 40 Proof of Concepts. • Development Marketplace grant scale up and partnering with government. • Bill & Melinda Gates Foundation grant received for applying Motech suite in Bihar for integration of IVR based system and mobile-based applications (no role for system integrator).	• Grants for innovations and creating the evidence base. • Working with Bill & Melinda Gates Foundation on integration of CommCare with MOTECH suite (with CommCare as the front end and MOTECH as the backend).

uffers from a high maternal and infant mortality rate, especially in reas, where poor women do not receive effective care and one in 22 infants die within one year of life. The main problem involves or access, quality and accountability of services provided by ament Accredited Social Health Activists (ASHAs).

g in 2010, Dimagi has deployed CommCare—a mobile-based, supported, open-source application that runs on inexpensive s—to address the challenges of standardizing the delivery of es by ASHAs. Multimedia aids enhance client engagement, quality nseling, and ASHA skills. Real-time data collection monitors s' activities and allows regular review of their performance

sult, there have been marked improvements in patient gement, quality of services, monitoring and accountability. i has developed a broad base of partnerships and platforms for mentation, funding, and collaboration to promote this technology tion in different geographical contexts and build an evidence or policy change.