

Strengthening Community Health Systems with Localized Multimedia

Derek TREATMAN¹, Neal LESH¹

¹*Dimagi, Inc., 529 Main St. Suite 606, Charlestown, MA 02129, USA
Tel: +1.617.580.3100, Email: information@dimagi.com*

Abstract: Many Information and Communication Technology (ICT) systems are currently used to support Community Health Workers (CHWs) in impoverished populations. However, the majority of these systems are text-based, making them difficult to use in areas of low literacy. We have added multimedia to one such system, CommCare, to aid CHWs in counseling clients and promoting healthy behaviors in their communities. This paper explores the benefits and challenges introduced by using multimedia CommCare through a qualitative review of CHW/client interactions and implementer interviews. We find that multimedia increases client engagement as well as CHW credibility and suggest identifying an engaging speaker and determining optimal audio message length as potential strategies for creating effective multimedia.

1. Introduction

There are number of Information and Communication Technology (ICT) systems in use today [1][2][3][4][5] which support community health programs and Community Health Workers (CHWs) in Lower and Middle Income Countries (LMICs), known informally as ICT4CHW. To date there have been few studies evaluating the utility of multimedia in such systems; rather most studies have focused on the effectiveness of the ICT4CHW systems as a whole. In this paper we will discuss the benefits and challenges introduced by adding multimedia to one such ICT4CHW system, CommCare.

In a recent study DeRenzi *et al.* identified six Health System Functions (HSFs) in which mobile tools support CHWs: data collection, training and access to reference material, communication between health workers, decision support, supervision, and promoting healthy behaviors in the population [6]. Although CommCare supports many of the HSFs defined above, we will focus on promoting healthy behaviors in the population, as this function is most affected by the addition of multimedia.

We will first discuss motivation behind adding multimedia to CommCare and the process of creating multimedia content. We will then describe eight different multimedia CommCare deployments implemented during 2010 and 2011 and present qualitative data collected through interviews with the implementers involved. Through review of this data we will describe the benefits of using multimedia, namely that it improves engagement in CHW/client interactions, increases CHW credibility, and is more desirable to use and more portable than conventional job aids. We will also describe the challenges introduced by the inclusion of multimedia, namely the difficulties of finding a good illustrator and speakers, design challenges of creating appropriate imagery and audio messages, and the time commitment needed to properly refine content.

In summary, the main contributions of this paper are to provide preliminary evidence that multimedia is a powerful tool for ICT4CHW systems and suggest potential strategies for creating effective imagery and audio messages.

2. Background

2.1 Community Health Workers

CHWs in LMICs are the first and often only link to healthcare in rural communities, but receive only limited training [7]. Many studies have shown that their performance is often suboptimal [8][9][10][11], which contributes to suboptimal use of health facilities by those in their communities. However, increased CHW performance could increase utilization of healthcare facilities by vulnerable populations [8]. CHWs and the populations they serve in LMICs have low levels of education and literacy, especially among women. Regardless, in such populations mobile phones are widely accepted and used [12]. This growing prevalence of mobile phones can be leveraged to better support CHWs as healthcare providers [13], as well as creating a support network between CHWs, their supervisors, and other supporting healthcare providers.

2.2 India

The World Health Organization reports the highest number of maternal deaths per year in India [14]. Over 60% of deliveries occur at home without the assistance of a skilled birth attendant [17]. However, studies have shown that by moving deliveries from the home to the hospital, maternal mortality can be reduced by half [18]. The National Rural Health Mission (NRHM) incentivizes institutional deliveries and the use of government health facilities in rural areas and provides services to underserved communities including vaccinations, nutritional supplements, and family planning methods [19]. Its services are facilitated by a cadre of CHWs including Auxiliary Nurse Midwives (ANMs), Anganwadis (AWWs), and Accredited Social Health Activists (ASHAs). ASHAs are the most mobile of these three CHWs and are expected to visit the homes of clients in their respective villages to promote health services and facilitate pediatric and prenatal visits to local facilities. ASHAs receive the least training: 23 days broken into 5 training sessions, which are spread out over 5 years in some locations.

2.3 ASHA Program

“ASHA will be the first port of call for any health related demands of deprived sections of the population, especially women and children, who find it difficult to access health services” [20]. The ASHA program was initiated in 2005 with the goal of one ASHA being selected by local officials to cover every village of population 1,000. 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 8 years of formal education. However, these requirements “may be relaxed if no suitable person with this qualification is available” [20]. The authors and other studies involving ASHAs [15][16] have found that the actual education level of ASHAs varies quite widely and although most ASHAs tend to be literate, some are not.

ASHAs often have low status in the community due to the fact that no ASHA originates from the village where she works, rather she is married into it, and low credibility due to the perception that her work is performed solely for personal gain because of financial incentives. There are often delays in payment or insufficient payment from the PHCs to the ASHAs for completed incentivized services. All of these challenges have a strong adverse effect on an ASHA’s motivation [15].

ASHAs are often provided flip-charts or booklets that contain written information on one side and illustrations and key points on the other side for her clients to look at. Despite instruction by supervisors, these flip-charts are often left behind when an ASHA leaves home to visit a client because she simply doesn’t want to carry them. Although books and other reference materials are useful for trainers, they are not appropriate for CHWs unfamiliar with the concept of seeking information inside a text [16].

2.4 CommCare



Figure 1: Screenshots from a multimedia CommCare application.

CommCare is an open-source mobile platform built using the JavaROSA code base [21]. The mobile platform is supported by a server, CommCareHQ [2], which allows implementers to design CommCare applications, manage users, monitor data submitted by users, and correspond with users via SMS. Unique CommCare applications can be created with easily customizable Xforms [22]. CommCare uses UTF-8 encoding [23] and supports the use of many languages and scripts. CommCare applications can be designed to for client registration and tracking, decision support, and educational job aids. CommCare has been used for numerous ICT4CHW deployments in 10 countries to date [2] and has been shown to be effective at improving adherence by CHWs to clinical protocols [24].

3. Motivation for Multimedia

In this section, we draw on existing evidence and field observations that support the potential for improving ICT4CHW systems with multimedia.

3.1 Multimedia Improves Health Worker Performance

The amount of information that CHWs are expected to remember from limited training sessions is often unrealistic, leading to poor protocol compliance. In a CHW study using the GuideView system [5] in which subjects were presented with audio, image, and video cues on a mobile phone to guide them through procedures, Florez-Arango *et al.* showed that rich media guidelines presented in a highly structured manner increased protocol compliance[7]. In another study in which ASHAs used videos on mobile phones as a tool for counseling, Ramachandran *et al.* report that ASHAs were more comfortable counseling with use of the mobile phone's video cues than without them and expressed concern that they might forget key points if conducting counseling without the phone [15]. CHWs infrequently carry paper flip-charts and registers with them on client home visits due to their weight and bulk, despite instruction by their trainers and supervisors to always carry such materials. A mobile phone is easily portable and unlikely to be left at home. Additionally, informative messages are played aloud instead of having to be read, allowing use by low-literate CHWs.

3.2 Sensitive Topics – Multimedia Speaks When People Can't

Topics like HIV testing and reproductive health can be particularly sensitive. CHWs often work in their own communities which makes these topics even more difficult to broach. Presenting sensitive subjects on a mobile phone in the form of audio messages makes it easier for the CHW and client to discuss as dialogue can be directed to or from the phone, which acts as an anonymous third party in the conversation.

“Before if we met a woman on the road, I would talk to her for a couple of minutes and consider that as part of my quota or work. Now I sit down and go through each point. Nothing gets missed.” – ASHA, Rajasthan

Another way in which a phone can become a benevolent third party in a conversation is in advocating for the CHW. An audio message directed to a client like “remember to call your ASHA when you go into labor, she will help you get to the health facility in time for your delivery,” could dissuade suspicion that the ASHA is promoting this behavior to get incentives provided by the NRHM.

3.3 Multimedia Improves Engagement and Credibility



Figure 2:left: A crowd gathers to watch an ASHA counseling a client with multimedia CommCare; upper-right: A client’s neighbors sit in on an ASHA’s counseling session; lower-right: Explaining information to a client’s family member.

Multimedia draws attention. In the authors’ experience, when an ASHA shows her phone to a client and plays a message within earshot of anyone else, they immediately come over to see what is happening. Ramachandran *et al.* similarly report that their video tool engaged not only clients, but family members, who may ultimately be the health decision-makers [16]. In Figure 2 a photo shows a client’s family member becoming involved in a counseling session, after having asked to see the information displayed on the mobile phone more closely.

When used as a tool for counseling, a mobile phone that presents multimedia becomes an anonymous third party in the conversation. The phone becomes a focus point and helps direct discussion to the topics displayed on the screen. Clients will often assume that recorded messages presented by a CHW have come from a higher authority like a doctor or health expert, which increases the credibility of those messages. This in turn increases the credibility of any further counseling provided by a CHW.

“They think that someone higher-up is speaking, someone who knows more than us. This is why they listen and believe what we’re saying even more.” – ASHA, Uttar Pradesh

4. Multimedia CommCare

Eight different multimedia CommCare deployments were implemented during 2010 and 2011 as 3 to 5 month pilots with possible scale up afterwards, summarized in Table 1. Different

field staff from Dimagi, Inc. supported each of the deployments, resulting in shared knowledge and resources like illustrations. The goal of each deployment was to assess the usability of multimedia in CommCare as a support tool for CHWs in Maternal and Child Health (MCH) initiatives. In most deployments CommCare was used specifically by ASHAs, but one deployment mentioned here and other deployments outside of India involved different types of CHWs with similar roles in counseling clients and conducting home visits.

Table 1: Multimedia CommCare deployments implemented between June 2010 and June 2011

Site	# CHWs	Implementing Organization	Subject	Objective	Multimedia	Languages
Bahriach, Uttar Pradesh, India	15	IntraHealth International	Maternal Health	Client counseling	Image, Audio	Hindi
Jhansi, Uttar Pradesh, India	15	IntraHealth International	Maternal Health	Client counseling	Image, Audio	Hindi
Kaushambi, Uttar Pradesh, India	10	Catholic Relief Services	Maternal Health	Client counseling and tracking, CHW monitoring	Image, Audio	Hindi
Deoghar, Jharkhand, India	10	NEEDS ¹	Maternal Health	Client counseling and tracking, CHW monitoring	Image, Audio	Hindi
Kishangarh, Rajasthan, India	10	Save the Children, IHAT	Maternal Health	Client counseling and tracking, CHW monitoring	Image, Audio	Hindi, Marwari
Khandwa, Madhya Pradesh, India	10	Real Medicine Foundation	Child Nutrition	Data collection, referral generation	Audio only	Hindi
Dodoma, Tanzania	32	ITIDO ²	Newborn Health	Client counseling, CHW monitoring	Image, Audio	Swahili
Herat, Afghanistan	10	World Vision Afghanistan	Maternal Health	Client counseling, CHW monitoring	Image, Audio	Dari

¹Network for Enterprise Enhancement and Development Support

²Invention and Technological Ideas Development Organization

4.1 Content

Each of the implementations discussed here started with an MCH protocol for CHWs designed by the implementing organization using the spreadsheet exemplified in Figure 3. This content was reviewed and iterated upon by MCH specialists to validate information in each message and ICT specialists to ensure optimal message length, image size, and image detail for use on a mobile phone. Protocol content was translated from English to the language most commonly spoken by the CHWs at each implementation site and some terminology was changed to appropriately fit the culture and educational level of clients.

Content was organized such that it could be presented in a single counseling session between a CHW and client, using skipping logic to display only information pertinent to the client being counseled, based on answers to preceding questions. For example, after recording a pregnant woman's expected delivery date, information most pertinent to a woman in either her first, second, or third trimester would be displayed. If recorded that a client had previously completed her tetanus vaccination then on subsequent visits the tetanus vaccine question would no longer be displayed, keeping the length of the counseling session short.

visible text (eng)	visible text (hin)	audio description (eng)	audio description (hin)	image
four examinations	चार जाँचे	It is important to visit the ANM or health center for 3 to 4 check-ups during pregnancy. The ANM will make sure there are no problems for you and your baby and will help you and your baby stay healthy. Did you know this?	गर्भवस्था के दौरान स्वास्थ्य केन्द्र या अंगनवादी केन्द्र पे अपने तीन से चार बार जाँच करवा लो। क्या आप यह जानती हैं?	
wholesome food	पोषित आहार	Do you take at least 4 meals daily including more green vegetables like palak and sarson, more dals, milk, jaggery, eggs, and fish?	क्या आप कम से कम दिन में चार बार भोजन लेती हैं जिसमें हारे पत्तेदार सब्जियाँ जैसे पालक, सरसो, दाल, गूड़, दूध, दही, अंडा, मीस और मछली?	
iron tablets	आयरन गोली	Pregnant women should start consuming iron and folic acid tablets on a daily basis for 100 days. Iron and folic acid tablets help in the production of blood and help in prevention of diseases which effect the health of the baby as well as the pregnant women.	गर्भवती को गर्भ का पता चलने के तीन महीने बाद से एक आयरन की गोली रोज 100 दिनों तक लेना आवश्यक है। जिससे कि गर्भवती को खून की कमी न होने पाये क्योंकि गर्भवस्था में खून की कमी से गर्भवती महिला को बहुत सी परेशानियाँ हो सकती हैं।	

Figure 3: Example of collaborative spreadsheet used to define and iterate upon visible and audible content.

4.2 Illustrations and Audio Recordings

For deployments in India, an initial set of color illustrations intended to fit the MCH protocols were drawn by a compensated, native Indian illustrator to ensure that they were culturally appropriate. After review and correction, illustrations were then post-processed to fit CommCare image dimension specifications by an ICT specialist from Dimagi.

Audio recordings were recorded by an area native speaker whose primary language was commonly shared amongst the CHWs. When multiple languages were common in an area, the official language as defined by the state was used, but speakers were instructed to use local terminology to ensure better understanding by the targeted population. Recordings were performed in a quiet room and were conducted by an ICT specialist from Dimagi who then post-processed and encoded the recordings for use in the CommCare application. Audio recordings often underwent a series of iterations through review by both MCH specialists and CHW focus groups to ensure their clarity, appropriateness, and ease of understanding.

After a complete application was compiled, the CHWs were trained as a group. The implementation team spent a number of weeks following individual CHWs on routine visits to observe their interaction with clients. Based on observations, improvements were made to the content and typically 2 to 3 revisions were made to the application during the first 3 months of implementation. For each revision, anywhere from a few to 60 new audio recordings were made, and occasionally a few new illustrations were created.

5. Results

5.1 Method

We conducted independent, qualitative interviews with 8 implementers to understand common benefits and challenges introduced by the inclusion of multimedia to CommCare. We analyzed notes taken during interviews, identified recurring concepts, and assigned a weighted score for each concept mentioned, based on the contextual importance of the concept as described by the interviewee or the number of times the concept was mentioned. Concepts with highest frequency and ranked with highest importance are compared here.

5.2 Design Challenges

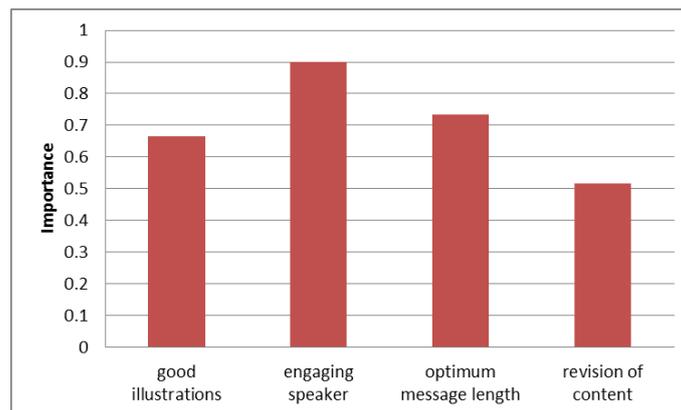


Figure 4: Multimedia design challenges ranked by importance to implementers.

The addition of multimedia to CommCare introduces new challenges to system design, including the procurement of multimedia and ensuring its quality. Implementers consistently stated that audio messages were more important than illustrations because audio messages contain more information whereas illustrations act solely as visual cues. Figure 4 shows that identifying an engaging speaker for the audio recordings was most crucial to creating an effective application. Five implementers noted that keeping audio messages

“short enough” or including only key points to create “optimum messages” was essential for better counseling compliance by CHWs.

Three implementers worked with pre-existing images from external sources including MCH handbooks and illustrated, paper flip-charts. These images were not designed for use on a mobile phone, which is limited by screen size and resolution. In such cases implementers described difficulties introduced by poor quality images from paper scans and the inability to modify the images. Most deployments in India shared illustrations made by a native Indian illustrator, which were designed specifically for use on mobile phones.

5.3 Benefits of Multimedia CommCare over Conventional Job Aids

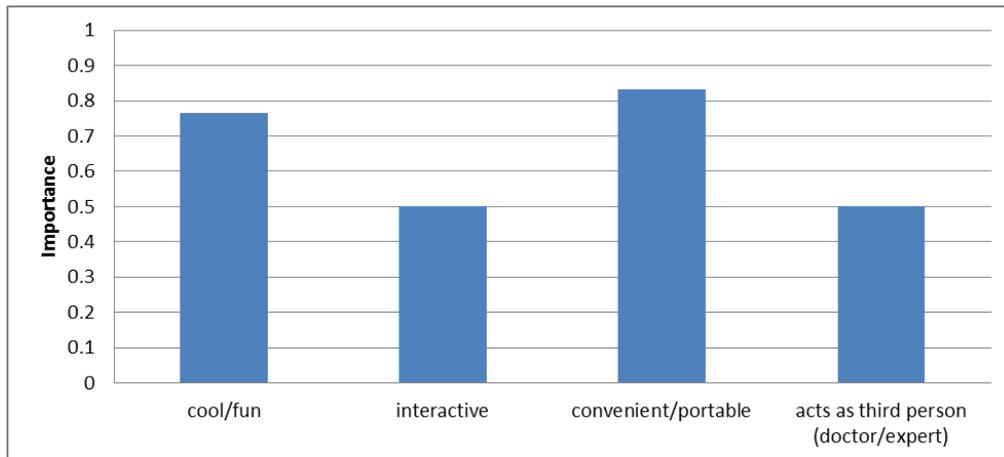


Figure 5: Benefits of multimedia CommCare ranked by importance to implementers.

The most important benefits to using multimedia CommCare were related to the simple fact that multimedia were presented on a mobile phone. Mobile phones are a status symbol in LMICs and the fact that CHWs could use them to show their clients images and play audio messages was seen as “cool” and “fun”. Implementers cited that mobile phones are far more convenient and portable than conventional job aids which are often “heavy” or “bulky”, resulting in them being left behind at CHWs’ homes while out on counseling sessions. At a recent, unrelated CHW training attended by one implementer and her cadre of CommCare-using ASHAs, the trainers handed out illustrated flip-charts on a new topic. The implementer quoted one ASHA saying, “we have mobiles, why do we need another flip-chart?”

Another important benefit is that a mobile phone playing audio messages becomes a live actor in CHW/client interactions, who is assumed to be an “expert”, “doctor”, or other “credible authority”. One implementer mentioned that clients would often ask who the speaker was, to which CHWs would respond “a lady doctor.”

5.4 Multimedia Can Be Reused

In all cases, implementers expressed the belief that illustrations from their deployments could be reused in other deployments involving similar subject matter. Audio messages for each deployment were recorded on site by an ICT specialist from Dimagi. Implementers expressed the belief that those messages could also be reused in other deployments geographically close enough that differences in dialect would be insignificant. Only one implementer commented that the time required to record and post-process audio messages was a significant challenge, while all others expressed that once an engaging speaker had been found, recording and post-processing was a trivial matter which required only a couple days of work.

Seven implementers believed that multimedia from their deployment would still be useful if used with CHWs who had higher education or training, but were less certain that the multimedia would be useful if presented alone to a client instead of by a CHW. Two

implementers stated that such multimedia would not be useful for clients alone because of technical challenges of using the phone and lack of motivation to do so in the first place.

5.5 When Multimedia is Not Appropriate

Implementers concluded that the only situation in which multimedia was not potentially beneficial was if the ICT4CHW system was only used for data collection (and not counseling) and the CHWs were fully literate. In such a case, it was stated that a multimedia component may slow the CHWs down in their data collection tasks.

Four implementers expressed concern that standardization of messages is not always helpful since it may hinder the CHWs ability to deliver personal messages to his or her clients. The goal of CommCare in these implementations was to support the CHWs in counseling sessions, not act as a crutch. However, implementers noted that the ability to play audio message on demand (CommCare currently supports one-button play for audio) mostly averts this issue as CHWs can play any message only when desired. It was also noted that playing audio served as a helpful reminder for the CHWs on what to say and that for poor performing CHWs playing only the audio messages was still better than no counseling at all.

The most agreed upon failure of multimedia is its use in noisy or crowded places or with multiple clients at once. The mobile phones' technical limitations of small screen size and low speaker volume make them difficult to use if there is extraneous noise, for example when a generator is running outside of a client's house, or if multiple people are trying to see the screen at once.

6. Discussion

Based on the experiences collected in implementer interviews, we suggest potential strategies for designing effective multimedia for ICT4CHW deployments.

6.1 Identify Good Sources – Illustrator and Speakers

Finding a good illustrator and speaker can take a substantial amount of time. The illustrator should ideally be native to the intervention area to a degree that he or she is familiar with the typical style of dress, foods available, personal appearances, habitats, and general way of life of the target population. One should assume that multiple iterations on the illustrations may be required to get them right, so availability of the illustrator throughout the design and initial implementation stages is important.

Pre-existing images can be used, but they must first be tested for usability on the mobile device and all available images should be inventoried. If using pre-existing images it must be taken into account that content outside of the existing inventory will not be covered which may cause future problems if modifications are needed or new content is desired.

The speaker should ideally be native to the intervention area to the degree that he or she speaks the same language shared amongst the CHWs and the majority of the target population. If the intervention covers a geographical area including multiple different dialects, use the CHWs as the common denominator. If the CHWs themselves speak different dialects, it may be worth the time commitment to create different version audio recordings to appropriately cover each primary language spoken. The speaker's voice should be clear and annunciated and he or she should be able to speak naturally at a pace slower than normal conversation for better clarity. We recommend giving auditions to a number of potential speakers and possibly choose one or more to perform the audio recordings, allowing for choice between multiple sets of recordings and different actors. Messages may need to be recorded many times for correct content and presentation, so availability of the speakers throughout the design and initial implementation stages is also important.

6.2 Getting the Audio Right

Audio messages should be designed to be as short and concise as possible, focusing on the key components of the information. A message that is too long may become a crutch for CHWs or hinder their ability to counsel. A message of optimum length will act as a reminder and prompt the CHW to give additional information or counseling on the topic described. Close attention should be paid to the terminology included in the message to ensure understandability by both CHWs and the target population. Messages should be reviewed by the CHWs and, if possible, observed periodically to ensure maximum understandability.

Setting up a comfortable and quiet recording environment is essential. Use a quiet room and remove potentially noisy jewelry. If possible, use a high quality microphone with a windscreen to avoid capturing the speaker's breathing. The implementer should monitor the audio with headphones for the duration of the recording and note down whenever a mistake is made or the recording is not clear. It is best to wait until all intended messages have been recorded and then ask the speaker to re-record certain messages.

To produce more natural speech, it may be useful to record messages in the form of a dialogue between two people. In this case be sure to instruct the speakers to speak at a pace slower than normal and to pause before responding to each other.

6.3 Getting the Images Right

Color illustrations were preferred in all implementations. As mentioned by one of the implementers, color can be used to highlight specific important elements or objects in the illustration. Specific attention should be paid to details like clothing, which may signify status or a profession, and the appropriateness of objects or symbols for the target population. For example, skull and crossbones may not signify danger for certain cultures and a depiction of a calendar may not be understood as pertaining to a date.

7. Conclusion

Through review of qualitative data we have identified benefits of using multimedia CommCare to support CHWs in promoting healthy behaviors in the population including increased engagement of both the CHW and client during counseling sessions, increased credibility of the CHW as a result of audio messages being perceived by clients as having come from a third party "expert" or "doctor", and increased acceptability of multimedia CommCare as a job aid tool because it is "cool" and "fun" as well as more convenient and portable than "bulky", conventional job aids. By interviewing implementers of multimedia CommCare deployments we have also identified additional challenges multimedia brings to application design including identifying an engaging speaker for audio recordings and balancing the length of audio messages to prompt further counseling rather than becoming a crutch. Multimedia content must be reviewed by CHWs and iterated upon until its understandability and appropriateness for target populations is assured.

Multimedia is a powerful tool for promoting healthy behaviors in LMICs and the ICT4CHW space would benefit from additional work evaluating such interventions.

8. Disclosures

Potential conflict of interest: Derek Treatman and Neal Lesh work for Dimagi, Inc. which developed CommCare and is seeking further funding for CommCare through grants and contracts. They could benefit financially from a positive perception of CommCare.

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