Using an eIMCI-Derived Decision Support Protocol to Improve Provider–Caretaker Communication for Treatment of Children Under 5 in Tanzania

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In Tanzania, significant effort has been made to reduce under-5 mortality rates, and the efforts have been somewhat successful in recent years. Many factors have contributed to the success, such as using standard treatment protocols for sick children. Using mobile technology has become increasingly popular in health care delivery. This study examines whether the use of mobile technology can leverage a standardized treatment protocol to improve the effect of counseling for children’s caretakers and result in better understanding of what needs to be done at home after the clinical visit. A randomized cluster design was used in clinics in Dar es Salaam, Tanzania. Children were treated using either test electronic protocols (eIMCI) or control paper (pIMCI) protocols. Providers using the eIMCI protocol were shown to counsel the mother significantly more frequently than providers using the pIMCI protocol. Caretakers receiving care by providers using the eIMCI protocol recalled reporting significantly more problems and advice concerning when to return and medications than those receiving care by providers using the pIMCI protocol. There was no significant difference among caretakers regarding the frequency and duration of administering medications. This study indicates the use of mobile technology is an important aide in increasing the delivery and recall of counseling messages.

Introduction

Although there has been significant progress in lowering rates of childhood mortality in Sub-Saharan Africa, few countries in Africa will reach the Millennium Development Goal (MDG) to reduce the under-5 mortality rate by two thirds. In Tanzania, where significant efforts have been made to achieve this goal, the under-5 mortality rates have dropped from 166/1000 live births in 1990 to 52/1000 births in 2013 (World Bank Development Indicators, 2013). Many factors have contributed to this impressive reduction in childhood deaths, including immunization programs, malaria control programs, and the use of standard treatment practices for sick children. The latter, known as the Integrated Management of Childhood Illness (IMCI), is the official government policy in Tanzania (Tanzania Ministry of Health, 2008). However, several studies have shown that providers in Tanzania, similar to providers in many low-income countries, do not consistently adhere to the IMCI protocol (Bryce et al., 2005; Bryce, Victora, Habicht, Vaughan, & Black, 2004). Poor protocol adherence is attributed to many factors, including inadequate training, overburdening workload, lack of supervision, and a deficiency of resources to effectively provide patient care (Rowe et al., 2009, 2011; Walter et al., 2009). Furthermore, the IMCI handbook is lengthy—approximately 163 pages (World Health Organization [WHO], 2007), and may be cumbersome for providers to follow at the point of care.

Even when IMCI protocols are correctly used to diagnose and treat a child, the caretaker (usually the mother) of these children are seldom given sufficient counseling on what is
wrong with the child and what is the treatment being given to the child (WHO, 2010). Thus, even if a child is prescribed the correct treatment, often it will not be correctly given to the child due to lack of understanding by the caretaker. Cultural norms and poor health literacy rates may contribute to a lack of communication between providers and caretakers, resulting in insufficient caretaker understanding and a resulting inability to fulfill treatment plans.

**Background**

The use of mobile technology has become increasingly popular in health care delivery as a way to improve quality and data collection. In previous studies in Tanzania, an electronic version of the IMCI decision support protocol, the eIMCI, was shown to improve the quality of health service delivery in pediatric patients by improving provider adherence to the IMCI protocol (DeRenzi et al., 2008; Mitchell, Hedt-Gauthier, Msellemu, Nkaka, & Lesh, 2013). Building upon this work, and the work of our partners who developed an IMCI-derived clinical protocol for treatment of children under 5 (Rambaud Althaus, Shao, Kahama-Maro, Genton, & D’Acremont, 2015), this study examines whether the use of mobile technology can improve the effect of counseling of children’s caretakers and result in better understanding of what needs to be done at home after the clinical visit.

The communication that occurred between the provider and the child’s caretaker was examined in terms of (a) what the provider said to the caretaker during the visit and (b) what the caretaker recalled from what they were told by the provider. The three topics of communication in the protocol that were examined included (a) the diagnosis or problem of the child, (b) when to return to the health facility in cases of worsening of symptoms or a specific number of days, and (c) how to administer the medications prescribed for the child’s treatment (Figure 1).

**Methods**

An IMCI-derived decision support protocol, the development and implementation of which is described in other studies (Perri, Shao, Swai, Mitchell, & Staggers, 2014; Rambaud Althaus et al., 2015; Shao et al., 2011), was used as the basis for healthcare delivery. This study aimed to test whether the use of mobile technology at the point of care could improve the knowledge of the caretaker as to what is needed to be done when they go home when compared with a control group. A randomized cluster design was used in which clinics in Dar es Salaam, Tanzania were assigned to a test group or a control group, and all providers at the clinic and all patients seen at a specific clinic were then treated using either electronic (test) protocols or paper (control) protocols.

Clinics were selected from government census reports, and then within each strata clinics were randomly assigned to a study arm of paper IMCI-derived protocol (pIMCI) or electronic IMCI-based protocol (eIMCI).

Participants for the study were (a) consenting providers who worked in the outpatient department of study-participating government clinics, and (b) caretakers of children under five who sought medical care at the participating government clinics. Provider inclusion criteria were the ability to read English, attended children under five during regular clinic duties, willingness to have an observer present during their clinical encounters, and able to be present to attend training sessions and clinic days during data collection. There were no exclusion criteria for providers. Caretaker inclusion criteria included seeking care for a child under 5 suffering from an acute illness, willingness to have their children treated using the respective protocols, willingness to have an observer present in the room during the clinical encounter, and willingness to be interviewed immediately following the visit. If the child exhibited obvious severe illness or danger signs the caretaker was excluded so that the child could be treated immediately.

Six municipal health clinics were selected and randomly assigned to intervention arm for this pilot study, with three facilities implementing the pIMCI protocol (provider \( n = 25 \)) and three facilities implementing the eIMCI protocol (provider \( n = 41 \)). The caretaker sample included caretakers seeking care for children ages 2–59 months at the participating clinics (pIMCI arm \( n = 180 \), eIMCI arm \( n = 172 \)). Table 1 summarizes the demographic characteristics of the provider and caretaker participants. Providers were different in terms of gender and age, with the pIMCI arm clinics having more females, who also tended to be about five years older than providers in the eIMCI arm. Of note was that the education level for the majority of caretakers in both arms was primary school or less.

The communication that occurred between the provider and the child’s caretaker was evaluated in terms of (a) what the provider said to the caretaker during the visit and (b) what the caretaker recalled of what they were told by the provider. If providers in either arm adhered more frequently to the communication prompts, it was expected that increased caretaker knowledge at the completion of the clinical encounter would result.

The test arm of the study (electronic arm) included a 25-s video formatted for the mobile phone aimed at educating caretakers on relevant health information, embedded prompts within the protocol containing key messages for caretakers, and a customized summary screen compiling the results of the clinical encounter. The control arm (paper arm) provided equivalent information to the electronic counseling messages in written text as part of the protocol.

Participating providers were trained over the course of two sessions. The first sessions were 2-day group workshops in which both arms received training on the rationale for updating the WHO IMCI protocol and overview protocol training over the course of 1.5 days. Participants in electronic arm (41 providers) and paper arm (25 providers) were divided for the remaining half day to focus on learning how to deliver the protocol using their respective platforms. The second sessions consisted of face-to-face training during
which researchers gave providers individual training sessions in groups of one to three, allowing for designated time to practice and familiarize the providers with their respective platforms for protocol delivery. Logistical navigation and phone operation (as relevant, for eIMCI) was emphasized for face-to-face sessions. This training occurred in the weeks immediately before data collection.

An observer was present during each clinical encounter recorded the provider’s actions related to the communication prompts given by the protocol. Immediately after the clinical encounter, an exit interviewer accompanied caretaker subjects to a separate area for the caretaker interview, during which they were asked to recall the same specific points of key health information communicated by the provider.

All data were entered into a central database built using EpiInfo database software v3.5.1. Data were exported into Excel (Microsoft Excel for Mac, version 12.3.2, Microsoft Corp., Redmond, WA) for cleaning and preparation for

### Table 1. Participant demographic summary

| Provider characteristic (eIMCI n = 41, pIMCI n = 25) | eIMCI | pIMCI | p   |
|-------------------------------------------------------|-------|-------|-----|
| Mean age                                              | 37.65 (SD = 9.5) | 42.16 (SD = 5.0) | <.001 |
| Provider type: clinical officer                       | 100%  | 99.4% | .331 |
| Provider gender: female                               | 55.6% | 76.7% | .001 |

| Caretaker characteristic (eIMCI n = 172, pIMCI n = 180) | eIMCI | pIMCI | p   |
|---------------------------------------------------------|-------|-------|-----|
| Mean age                                                | 27.58 (SD = 6.4) | 28.06 (SD = 6.6) | .493 |
| Gender: female                                          | 94.2% | 95.6% | .817 |
| Relationship to child                                   |       |       |     |
| Parent                                                  | 91.3% | 94.4% | .363 |
| Other                                                   | 8.7%  | 5.6%  |     |
| Highest education level                                 |       |       |     |
| Primary school not completed                            | 11.6% | 10.0% | .660 |
| Primary school completed                                | 69.8% | 66.7% |     |
| Form 4 completed                                        | 14.5% | 19.4% |     |
| Form 6 completed                                        | 1.2%  | 1.1%  |     |
| University                                              | 0.6%  | 1.7%  |     |

**Figure 1. Communication key information points.**
Results

Communication Gaps Between Arms

Provider Verbalization of Key Information Points

Wide gaps between eIMCI and pIMCI arms were seen regarding problem verbalized (eIMCI = 98.8% vs. pIMCI = 77.8%, \( p \leq .001 \)), number of days to return (eIMCI = 66.3% vs. pIMCI = 45.0%, \( p \leq .001 \)), medication type (eIMCI = 97.0% vs. pIMCI = 80.8%, \( p \leq .001 \)) and medication frequency (eIMCI = 93.2% vs. pIMCI = 79.2%, \( p = .001 \)); although most providers verbalized at least one sign of worsening condition (eIMCI = 96.5% and pIMCI = 92.2%, \( p \leq .001 \)). The smallest gap was in information regarding medication duration (the number of days to take the medication), with no statistical difference between arms. In both arms, medication duration was verbalized frequently for Group 1 medications (eIMCI = 92.6% and pIMCI = 86.9%; \( p = .257 \)). Figure 2 displays the provider verbalization of communication prompts.

Furthermore, providers in the pIMCI arm did not verbalize the child’s problem in 22.2% of cases (compared with 1% in the eIMCI arm). Providers in the pIMCI arm did not mention any signs of worsening condition in 7.8% of cases (compared with 3.5% of cases in the eIMCI arm). Providers in the pIMCI arm were more likely to fail to say when to return to the clinic (number of days), although both groups failed to mention this information for more than one third of the children. Providers in the pIMCI arm did not verbalize the medication name in 19.2% of cases, medication frequency was not explained in 20.8% of cases, and medication duration was not explained in 13.1% of cases. Far fewer eIMCI arm providers failed to communicate the medication name (3.0% of cases), 6.8% did not verbalize medication frequency, and 7.4% did not verbalize medication duration. Caretaker Recall of Key Information Points

While significant deficits in caretaker recall were found in both arms, the most severe were found in the pIMCI arm. The widest gaps in caretaker recall were in days to return to the clinic, and the medication name/type. Caretaker recall of the days to return to the clinic was incorrectly reported (did not match what the provider stated) in 22.9% of eIMCI cases, compared with 50.0% of pIMCI cases (\( p \leq .010 \)). Caretakers in the eIMCI arm did not know any medications in 21.5% of cases for which medication names were verbalized by the provider, and for 42.2% of pIMCI cases (\( p = .001 \)).

Other deficits were also seen. Caretakers in the eIMCI arm did not know the child’s problem in 15.9% of cases, while those in pIMCI could not recall this information far more frequently—approximately one third of the time (31.4%; \( p = .005 \)). Caretakers frequently did not know the number of days to return, with 67.5% of eIMCI cases and 84.0% of pIMCI cases failing to recall this information correctly (\( p = .010 \)). Caretakers in 22.9% of cases in the eIMCI arm, and half (50%) of caretakers in the pIMCI arm were unable to correctly recall any signs of worsening condition (\( p \leq .001 \)). Caretakers in 21.5% of cases in the eIMCI arm, and in 42.2% of cases the pIMCI arm, did not know the medication name (\( p = .001 \)). Furthermore, 36.2% of caretakers in the eIMCI arm and more than half (58.8%) of caretakers in the pIMCI arm did not recall how often to give the medication (\( p = .036 \)) and most, in all cases, including 72.0% in the eIMCI arm, and 79.2% in the pIMCI arm, did not correctly recall how many days to give the medicine (\( p = .478 \)). Figure 3 displays caretaker recall among arms.

The smallest gap in caretaker recall among arms was found in the duration to administer treatment, with few caretakers in either eIMCI and pIMCI arms correctly reporting medication duration (28.0% vs. 20.8% correct, respectively), and no caretaker correctly recalled this information for more than one medication. Caretaker recall largely mirrored provider verbalization of the key information points in each arm, with the exception of medication duration.

In summary, providers using the eIMCI protocol (a) were shown to counsel the mother on the child’s problem significantly more frequently than were providers using the pIMCI protocol, (b) gave significantly more advice when to return in case of worsening illness or nonimprovement than were providers in the pIMCI group, and (c) verbalized significantly more information regarding medications including type of medication, frequency to administer, and duration to administer (\( p < .05 \)). Caretakers receiving care by providers using the eIMCI protocol recalled significantly more diagnoses or problems than did providers using the pIMCI protocol, recalled significantly more advice when to return in case of worsening illness or...
nonimprovement than did caretakers in the pIMCI group, and recalled significantly more types of medications prescribed ($p < .05$). There was no significant difference among caretakers in each group regarding the frequency and the duration to administer medications ($p > .05$).

**Discussion**

Most children who are taken to a health worker when they are sick are sent home with instructions to treat the child in a specified way. The assumption is that a caretaker will follow the specified treatment or return if the treatment is not working. However, unless the caretaker understands what this treatment is and when to return, the efficacy of the treatment is likely to be reduced. There is also evidence from previous studies that health workers routinely do not give adequate information to the caretaker resulting in confusion about what is expected once the child is taken home. Results of this study suggest that (a) the use of eIMCI can significantly improve providers’ thoroughness of what is communicated to the caretaker when compared to paper protocols, and (b) with the use of eIMCI caretakers retained more information at the completion of the visit. The electronic intervention was therefore considered to be effective by both measures of provider and caretaker components of the communication encounter.

While significant improvements were observed from eIMCI use, deficits in provider verbalization of key information points and caretaker recall of information verbalized remained, indicating a need for further improvement in provider-caretaker communication. Long-standing societal patterns likely influenced these deficits, as it has been a well-established norm for providers to abstain from teaching this information, and for caretakers to accept an insufficient level of communication and health related teaching.

**Implications**

Implications of this study indicated that both the delivery and recall of key information points were improved overall with the use of eIMCI. In cases where the provider adhered
to the communication prompts embedded within the protocol, the caretaker more often recalled these points than when the clinical encounter was guided by the paper protocol. This means that the use of eIMCI has the potential to not only increase the correct diagnosis and treatment of the sick child but also to increase the likelihood that the child will be given the correct treatment at home.

Limitations
This study aimed to test whether the use of mobile technology could improve a caretakers understanding of what treatment was to be given at home. Ultimately, we want to know whether the correct treatment was given and whether this resulted in better health outcomes. However due to resource constraints and the challenge presented in this context wherein individuals either do not own mobile phones, or change phone numbers and service providers frequently, this study did not follow up the children to see whether there was an improvement in health outcomes. Therefore, while we can say that mothers did better understand what they should do at home, we cannot say definitively that they followed this treatment protocol.

A second limitation is that the sample in this study was limited to urban centers in Tanzania. Thus, the results may not be generalizable to more rural sites. Further, the analysis used in this study was limited in that it ignored possible bias associated with randomized cluster sampling. The design has been used to reduce threats to study validity such as variable adherence to a protocol or differences in provider skill levels (Glynn, Brookhart, Stedman, Avorn, & Solomon, 2007). Cluster randomized designs, however, are perceived to have an inherently greater risk of bias (Puffer, Torgerson, & Watson, 2003), in that members in the same clinic could be influenced by factors inherent in the clinic, rather than as an effect of an intervention; statistically referred to as intraclass correlation (Wojdyla, 2005). Large sample sizes, which this study possessed, can help mitigate the perceived risks of the randomized cluster design (Glynn et al., 2007). In this study, all eligible providers who agreed to participate were enrolled, and a large number of caretakers were enrolled at each clinic.

A final limitation is that the effect of the video shown to the electronic arm caretaker participants was not measured independently of the rest of the intervention, nor were recall rates retested at a different subsequent time, therefore it is unknown if caretaker recall rates differed between arms as time lapsed after the treatment encounter.

Conclusion
Although counseling is a critical component of health care, it is seldom done effectively. This is a particular concern when the counseling involves how to provide treatment to sick children since misunderstanding of what is required at home leads to ineffective treatment adherence and poorer health outcomes. This study indicates that the use of mobile technology can be an important aide in increasing both the delivery and recall of counseling messages.

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