

# Evaluation of a Mobile Health Application in the iCCM Program in Malawi

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## ABBREVIATIONS

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CHW	community health worker
DHMT	district health management team
DQA	data quality assessment
eHealth	electronic health
HSA	health surveillance assistant
iCCM	integrated community case management
IMCI	Integrated Management of Childhood Illness
M&E	monitoring and evaluation
MDHS	Malawi Demographic and Health Survey
MES	Malawi Millennium Development Goals Endline Survey
mHealth	mobile phones used in health care
mRDT	malaria rapid diagnostic test
MOH	Ministry of Health
MUAC	middle upper arm circumference
ORS	oral rehydration solution
RAcE	Rapid Access Expansion
SHSA	senior health surveillance assistant
WHO	World Health Organization

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## EXECUTIVE SUMMARY

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Efforts to reduce mortality among children under five years of age have led to the introduction of community-based interventions to improve access to life-saving interventions for the treatment of conditions responsible for the majority of deaths in this age group. The rise in the availability of mobile phones in low- and middle-income countries in the last decade has increased interest in the use of mobile technology in health programs to improve the quality of care. Although supporting electronic health through the use of mobile phones is often embraced by health care workers, experts warn that if used improperly, these strategies may have minimal impact on improving patient outcomes and only divert valuable resources. More evidence of better quality is needed to make the health and investment case for the scale-up of these technologies. The need is urgent for evaluations that will increase the evidence about the effectiveness of mobile technologies for improving data and health care quality.

In 2008, Malawi introduced integrated community case management (iCCM) services, delivered by community health workers called health surveillance assistants (HSAs). HSAs are the most peripheral cadre of health workers in the Ministry of Health (MOH).<sup>1</sup> HSAs provide iCCM services in hard-to-reach areas (defined as more than five kilometers from a health facility or the presence of a physical barrier to a health facility) to children two months to five years of age. The World Health Organization (WHO), Save the Children, and partners have implemented iCCM services in eight districts in Malawi that receive WHO technical support and funding through the Rapid Access Expansion (RAcE) program: Dedza, Likoma, Lilongwe, Mzimba North, Nkhata Bay, Ntcheu, Ntchisi, and Rumphi. In 2014, D-tree International developed a mobile application to help improve the quality of care provided by HSAs through accurate, effective classification and treatment of malaria, diarrhoea, and pneumonia among children under five years of age. The application adheres to the national iCCM protocol and guides HSAs through the assessment process to classify and recommend a treatment plan for each child. Starting in 2014, the mobile application developed by D-tree was piloted in four of the eight RAcE districts: Dedza, Mzimba North, Ntcheu, and Ntchisi.

The overall purpose of this study was to assess the value of using the D-tree mobile application in the iCCM program for better quality of care delivered to children under five years of age and for improvements in the quality of data reported by HSAs. The study addressed the following evaluation questions:

- **Quality of Care.** Does the use of the D-tree mobile application by HSAs improve the quality of care for children under five years of age, compared to the quality of care that children receive from HSAs who do not use this technology?
- **Data Quality Assessment.** How does the quality<sup>2</sup> of data, defined by availability, completeness, and consistency (a measure of accuracy), recorded by HSAs using the mobile application and submitted to the D-tree database compare with the quality of data recorded by HSAs using paper registers and reported to facilities using paper forms?

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<sup>1</sup> Nsona H, Mtimuni A, et al. 2012. Scaling up integrated community case management of childhood illness: Update from Malawi. *AMJTMH*, 87(5) supp: 54-60.

<sup>2</sup> Data quality consists of eight dimensions: accuracy, completeness, reliability, integrity, timeliness, confidentiality, precision, and availability of data (see *ICF DQA Guide: Adapted from MEASURE Evaluation. September 2008. Data Quality Audit Tool*). For this study, we assessed three dimensions—accuracy (captured through consistency), completeness, and availability of iCCM data.

- **Facilitators and Barriers to the Use of the Mobile Application.** What are the factors that facilitate or hinder implementation of the D-tree mobile application that will affect its adoption and scale-up for iCCM programs in other districts in Malawi and data use for program decisions?

This cross-sectional, mixed-method study included quantitative and qualitative data collection comprised of three inter-linked components:

- **Quality of Care.** A quasi-experimental study compared intervention and comparison groups to evaluate the effect of the iCCM mobile application on the adherence to iCCM guidelines by HSAs using the mobile application and paper versions of the protocol.
  - The intervention group consisted of HSAs trained in iCCM and using the mobile application as a decision support tool for classifying and treating sick children. These HSAs worked in four of the RAcE districts: Dedza, Mzimba North, Ntcheu, and Ntchisi. The comparison group consisted of HSAs who received the same iCCM training but who relied on the paper iCCM protocol to classify and treat sick children. These HSAs worked in the remaining three RAcE districts: Lilongwe, Nkhata Bay, and Rumphu.<sup>3</sup> HSAs were randomly selected from health facilities, stratified by the number of HSAs reporting to the facility. The first four sick children under five years of age presenting to the HSA for an initial consultation for their current illness episode were observed for assessment, classification, and treatment. The results were then compared to a gold-standard evaluator to determine the quality of care.
- **Data Quality Assessment (DQA).** A quasi-experimental study design included HSAs who use both the mobile application and the paper forms to collect and report data to the D-tree database and health facilities. The purpose of the study was to evaluate the quality of data submitted through the two methods.
  - The DQA component of the evaluation was a quasi-experimental study design that included the HSAs selected for the study in the four study intervention districts in which the mobile application was used. The assessment compared data that HSAs collected through the iCCM mobile application and submitted to the D-tree database to data that HSAs collected through village clinic registers and submitted to health facilities on monthly reporting forms for a two-month period (June–July 2016). The DQA focused on three dimensions of data quality: data availability, completeness, and consistency (a measure of accuracy).
- **Qualitative Analysis.** ICF conducted key informant interviews to collect qualitative data from stakeholders representing all levels of the iCCM implementation system (national, district, facility, and beneficiary) on their perceptions about quality of care, data quality, and use of data for decision making when using the mobile application in iCCM programs. The interviews helped provide context to the quantitative analysis (quality of care and the DQA). The qualitative data were also used to understand the facilitators and barriers to the implementation of the mobile application in an iCCM program and the use of data for decision making, and to recommend ways to improve and scale up the mobile application for iCCM in Malawi and beyond.

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<sup>3</sup> Although six HSA were trained in iCCM in Likoma, they were not considered for inclusion in the control group. Likoma is a small island in the middle of Lake Malawi. The small number of HSAs in this district was too low to warrant the added cost of travel to that district for data collection.

## Quality of Care

During the study, 160 HSAs using the iCCM mobile application and 132 HSAs using paper tools were observed. HSAs using the iCCM mobile application tended to assess sick children according to the iCCM protocol more often than HSAs using paper tools. In particular, a statistically significantly higher percentage of children seen by HSAs in the intervention group—the mobile application users—were assessed for four categories: cough (97.9 percent intervention group, compared to 90.7 percent non-intervention group); diarrhoea (93.9 percent intervention group, compared to 87.4 percent non-intervention group); the three general danger signs (87.6 percent intervention group, compared to 78.6 percent non-intervention group); and the five physical danger signs (79.9 percent intervention group, compared to 61.7 percent non-intervention group). The most differences occurred between the mobile application users and the paper form users in their evaluations of two of the three general danger signs: (1) checking if the child was able to drink or eat anything (94.9 percent intervention group, compared to 89.4 percent non-intervention group) and (2) checking for convulsions (92.8 percent intervention group, compared to 84 percent non-intervention group). HSAs in the intervention group were more likely to check for all of the components of the physical danger signs, with the exception of checking if the mid-upper arm circumference (MUAC) indicated adequate nutrition.

More than 80 percent of the HSAs who used the iCCM mobile application arrived at the same results as the gold-standard evaluator; that is, they correctly classified the sick children across common illnesses and danger signs, compared to 57.6 percent of HSAs that used the paper forms. Classification of illnesses that HSAs can treat, specifically fever for less than seven days and classification of a child as green on the MUAC tape, account for this discrepancy. HSAs, especially those using paper-based tools, tended to misclassify non-febrile children as having fever and failed to classify properly nourished children as falling into any color category. HSAs in both groups performed much better in classifying only the three common illnesses: malaria (as diagnosed by a positive malaria rapid diagnostic test [mRDT]), diarrhoea, and cough with fast breathing. However, HSAs using the iCCM mobile application outperformed HSAs using the paper tools by correctly diagnosing 91.3 percent of the three common illnesses, compared to 82.5 percent of HSAs using the paper tools.

Overall, children with malaria, diarrhoea, or cough with fast breathing received the correct treatment for their illnesses, regardless of the tool used—mobile application or paper forms—to guide treatment. We investigated the effects of use of the mobile application separately on each illness. HSAs in the intervention group tended to correctly prescribe an antimalarial drug to children with fever and positive mRDT more often than HSAs in the comparison group (80 percent intervention group, compared to 51.8 percent non-intervention group). Further investigation indicated no differences in treatment rates due to age band mixing, but differences were found in rates of offering any treatment. Of those HSAs incorrectly treating malaria, 66.5 percent failed to offer any treatment despite positive mRDT (62.4 percent of HSAs in comparison districts and 4.1 percent of HSAs in the intervention districts); HSAs indicated their treatment plan as if no drug shortages existed. HSAs in the intervention group who classified children as having one or more danger signs tended to refer these children to the nearest health facility more frequently (87.0 percent) than HSAs in the non-intervention group (70.8 percent). Less than 40 percent of the children treated by HSAs in either group received their first treatment dose at the village clinic. Furthermore, less than half of all HSAs in either group counseled caregivers of children with the three common illnesses to give directions on dosage, frequency, and duration of



administering treatments; demonstrate treatment; and require that caregivers repeat the directions for the treatment procedure.

The study also looked at the characteristics of HSAs who correctly treated malaria, diarrhoea, and cough with fast breathing. Male HSAs were associated with lower odds of correctly treating sick children, and with HSAs seeing more than 18 children per day on average. HSAs who had provided iCCM services for more than 5.1 years and HSAs who had received their most recent training as a refresher training were negatively associated with the correct treatment of children. This suggests that HSAs who started to provide iCCM services more recently, and hence had the initial training as their most recent training, tended to treat children correctly. On the other hand, HSAs who had at least completed Form 4 level of education were positively associated with correct treatment. Increased visits by the mentor, but not necessarily by the supervisor, were associated with improved odds of correct treatment; however, no association was found between correct treatment and the number of tasks the mentor conducted.

## Data Quality Assessment

Results show that the data collected by the 159 HSAs through their village clinic registers and monthly summary forms were of good quality, as measured by availability and consistency of data, compared to the quality of data collected and reported through the iCCM mobile application. Similar trends were observed across the four intervention districts, except in Ntcheu district, where a slightly higher percentage of HSAs (95.8 percent) had iCCM mobile application data available, compared to 84.7 percent of HSAs reporting through paper forms. The districts also had differences. For example, Dedza district had the lowest percentage of HSAs (49.8 percent) with iCCM mobile application data available and 75.7 percent data availability from paper forms. These differences in data availability could be explained by the frequent problems reported with the iCCM mobile application, including hardware malfunctions, failure to sync, shortage of power to charge the phones, and other challenges that limited the regular use of phones. Some HSAs chose not to use their phones during the sick child visits, even when the phones were in working condition. Instead they used the village clinic register during the visit and then copied that information into the mobile application later. More investigation is required to understand why only about half of HSAs in Dedza district reported data to D-tree.

Data completeness was high on the paper forms, with more than 84 percent of HSAs having entered all the required information on key indicators, including client information, assessment, classification, and treatment and referral. A smaller percentage of HSAs (33.1 percent), however, had complete information on patient follow-up in their village clinic registers, and 72.1 percent of HSAs had their monthly summary forms signed by their supervisor. This may indicate that the follow-up information and signature are incomplete because the HSAs view this information as low priority, compared to treatment-related data, which are closely monitored and are required to account for the drugs that have been used. Despite the commonly held view that data collected by HSAs through the village clinic registers are not correctly recorded, aggregated, and reported in the monthly summary forms, this evaluation shows that this was not the case in Malawi.

Differences were apparent in data consistency from the three data sources: village clinic registers, monthly summary forms, and the iCCM mobile application. In comparing the village clinic registers to the monthly summary forms, we found good agreement in the counts of mRDT and the number of

positive malaria cases and fast breathing cases. The data for diarrhea and referral were not as much in agreement; more cases were shown in the monthly summary forms than in the village clinic registers. In comparing the village clinic registers to the iCCM mobile application counts, we found higher counts in the village clinic registers for all indicators, except for the number of referrals with danger signs, than in the iCCM mobile application. Some of these results could be explained by the limited availability of data for the iCCM mobile application because most of the data were not being submitted to the D-tree database, perhaps because the HSAs were not always using their phones.

## Facilitators and Barriers to the Use of the Mobile Application

In the qualitative study, several informants at all levels of the iCCM implementation system felt that the use of the mobile application as a supportive tool to improve the quality of care and data quality was essential. They also mentioned several factors that had helped improve the implementation of the iCCM mobile application: collaboration among key stakeholders, such as MOH, implementing partners, technology development partner, and communities; regular training and supervision of HSAs; creation of super-users;<sup>4</sup> opportunities for HSAs to practice with the phone under the supervision of a mentor; HSAs' phone ownership; and recruiting of young HSAs.

Results also show that the informants identified several barriers to the use of the mobile application that included the lack of a national policy and limited MOH human and resource capacity to support iCCM program implementation; limited access to the D-tree database; and hardware problems with the phones. During fieldwork for this study, we found that a large number of HSAs who were supposed to be using their mobile phones for sick child visits did not. A surprisingly high percentage of HSAs (about 56 percent) in the intervention group said that they had used the village clinic register during a consultation. Anecdotal evidence suggests that this was often the result of hardware issues or problems with charging the phone battery. A more detailed study could further explore the perceptions that HSAs have about the usefulness of the mobile application to guide sick child treatment and the practical barriers to implementing the mobile application.

The qualitative study also sought the perspectives of key stakeholders on whether reporting data through the mobile application to the D-tree database facilitated using the data for decision making. The results showed that it has not. Several informants said that the data submitted to D-tree were not easily accessible or usable, and they were not comprehensive. These informants also said that they have noted some improvement in the database that might make it more user-friendly and accessible for decision making in future.

## Conclusions and Recommendation

Results of the study lend some support to the use of the mobile application as a tool to facilitate shifting tasks to less-trained health surveillance workers, especially considering the severe shortages of trained health personnel in the hard-to-reach areas of Malawi. The limited effect on treatment rates points to additional support required for adhering to the treatment protocol before any full-scale implementation of the mobile application. In addition, the use of the mobile application had little effect on the use of data

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<sup>4</sup> Super-users are HSAs trained to troubleshoot and resolve common issues that other HSAs encounter when using their phones and the iCCM mobile application. They are identified by the district teams in collaboration with D-tree staff based on their observed interest, skills, and performance in using the mobile application. *RACe 3rd Annual Report, May 2016*.

for decision making among HSAs in the intervention group compared to HSAs in the comparison group. In data reporting, the results from the DQA indicate better data reporting through the village clinic registers and monthly summary forms, compared to data reporting using the mobile application. More data were available and consistent when HSAs used the paper forms, compared to when they used the mobile application. This result, however, calls for policy makers and program staff to think about the broader contextual factors, such as network coverage, wear and tear on hardware and software, airtime, HSA age, and other factors that limit the continuous use of the mobile application. The perspectives of several key stakeholders from both intervention and comparison districts show that the stakeholders are in favor of expanding the use of the mobile application across the country. They also noted, however, that although the mobile application has potential, they were not sure if the resources needed are available to expand and sustain its implementation in the iCCM program.

# INTRODUCTION

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## Background

Efforts to reduce mortality among children under five years of age have led to the introduction of community-based interventions for improving access to life-saving interventions in the treatment of conditions responsible for majority of deaths in this age group.<sup>5</sup> Based on the World Health Organization (WHO) Integrated Management of Childhood Illness (IMCI) guidelines, integrated community case management (iCCM) is a proven strategy for managing childhood conditions in an integrated manner—assessing symptoms, classifying illnesses, and treating common childhood illnesses (malaria, diarrhoea, and pneumonia).<sup>6</sup> Although iCCM can help save lives,<sup>7</sup> reviews are mixed about the quality of care provided by community health workers (CHWs), the front-line workers for service delivery.<sup>8, 9, 10</sup> CHWs also routinely collect demographic and health data, critical for program management, surveillance, and evaluation. Reviews are similarly mixed about the quality of data collected by CHWs.<sup>11, 12</sup>

The rise in the availability of mobile phones in low- and middle-income countries in the last decade has increased the use of mobile technology in health programs to improve the quality of care, data quality, and data use for decision making in these countries. Mobile technology applications have been developed to provide assistance to health care workers as a decision support system and data collection tool and to improve communication in the health care system—for referrals, for information about the availability of medical supplies, and to reach clients.

Although electronic health (eHealth) through the use of mobile phones—known as mHealth—has been embraced by health care workers, experts warn that improper use of the technology may have minimal impact on improving patient outcomes and only divert valuable resources.<sup>13</sup> Studies looking at the role of eHealth as a decision support tool to improve the quality of care are often limited by location, design, and sample sizes. Findings from these studies have tended to conclude that the use of electronic decision support technologies improves the quality of care.<sup>14, 15</sup> Very few studies, however, have dealt

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<sup>5</sup> WHO and UNICEF. 2012. *Joint Statement: Integrated Community Case Management*. New York, NY: UNICEF.

<sup>6</sup> IMCI chart booklet, available at [http://www.who.int/maternal\\_child\\_adolescent/documents/IMCI\\_chartbooklet/en/](http://www.who.int/maternal_child_adolescent/documents/IMCI_chartbooklet/en/).

<sup>7</sup> Amouzou A, Morris S, et al. 2014. Assessing the impact of integrated community case management (iCCM) programs in child mortality: Review of early results and lessons learned in sub-Saharan Africa. *J Global Health*, 4(2):020411.

<sup>8</sup> Najjemba R, Kiapi L, et al. 2014. Integrated community case management: Quality of care and adherence to medication in Beneshangul-Gumuz Region, Ethiopia. *Ethiop Med J*, Oct;52 Suppl 3:83-90.

<sup>9</sup> Kalyango JN, Rutebemberwa E, et al. 2012. Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda. *Malaria Journal*, 11:282.

<sup>10</sup> Bosch-Capblanch X, and Marceau C. 2014. Training, supervision and quality of care in selected integrated community case management (iCCM) programmes: A scoping review of programmatic evidence. *J Global Health*, 4(2):020403.

<sup>11</sup> Otieno CF, Kaseje D, et al. 2011. Reliability of community health worker collected data for planning and policy in a peri-urban area of Kisumu, Kenya. *Journal of Community Health*, 37: 48-53.

<sup>12</sup> Mitsunaga T, Hedt-Gauthier B, et al. 2013. Utilizing community health worker data for program management and evaluation: Systems for data quality assessments and baseline results for Rwanda. *Social Science & Medicine*, 85: 97-92.

<sup>13</sup> Call to action on global eHealth evaluation: consensus statement of the WHO Global eHealth Evaluation Meeting, Bellagio, September 2011. Available at [http://www.ghdonline.org/uploads/The\\_Bellagio\\_eHealth\\_Evaluation\\_Call\\_to\\_Action-Release.docx](http://www.ghdonline.org/uploads/The_Bellagio_eHealth_Evaluation_Call_to_Action-Release.docx).

<sup>14</sup> Peters DH, Kohli M, et al. 2006. Can computers improve patient care by primary health care workers in India? *Int J for Quality in Health Care*, 18(6):437-445.

<sup>15</sup> Mitchell M, Lesh N, et al., 2009. Improving care—improving access: The use of electronic decision support with AIDS patients in South Africa. *Int J Health Care Technology and Management*, 10(3): 156-168.

explicitly with case management of childhood illnesses by CHWs. The limited evidence available suggests that decision support tools can improve classification of childhood diseases, promote adherence to the IMCI protocol, and result in treatment with proper drug dosage.<sup>16, 17</sup> More evidence of better quality is needed to make the health and investment case for a scale-up of these technologies.<sup>18</sup> There is an urgent need to conduct evaluations on the impact of mobile technologies on improving data quality and the quality of health care.<sup>19</sup>

## The iCCM Program and the Mobile Health Application

The under-five child mortality rate in Malawi has been decreasing steadily, from 234 deaths per 1,000 live births in 1992 to the still-high rate of 64 deaths per 1,000 live births in 2015.<sup>20</sup> Malaria, diarrhoea, and pneumonia account for approximately half of the deaths among children 1 to 59 months of age.<sup>21, 22</sup> In 2008, Malawi introduced iCCM services, delivered by CHWs called health surveillance assistants (HSAs). HSAs are the most peripheral cadre of health workers in the Ministry of Health (MOH).<sup>23</sup> HSAs provide iCCM services in hard-to-reach areas (defined as more than five kilometers from a health facility or the presence of a physical barrier to a health facility) to children aged two months to five years. Their responsibilities include assessing, classifying, and treating children who present with common childhood illnesses, such as uncomplicated cases of fever, cough with fast breathing, diarrhoea, and eye infections. HSAs also identify danger signs for more severe illnesses and refer these children, and any other children with illness that they cannot treat, to a nearby health facility. HSAs are required to document the care given to sick children in paper-based forms or the mobile application.

Save the Children and its partners have implemented iCCM services in eight districts in Malawi that receive technical support and funding from WHO through the Rapid Access Expansion (RACe) program. These eight districts are Dedza, Likoma, Lilongwe, Mzimba North, Nkhata Bay, Ntcheu, Ntchisi, and Rumphu. In 2014, D-tree International developed a mobile application to help improve the quality of care provided by HSAs through accurate, effective classification and treatment of malaria, diarrhoea, and pneumonia among children under five years of age in hard-to-reach areas. The application adheres to the

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<sup>16</sup> Mitchell M, Hedt-Gauthier BL, et al. 2013. Using electronic technology to improve clinical care—Results from a before-after cluster trial to evaluate assessment and classification of sick children according to Integrated Management of Childhood Illness (IMCI) protocol in Tanzania. *BMC Med Informatics & Decision Making*, 13:95. Available at <http://www.biomedcentral.com/1472-6947/13/95>.

<sup>17</sup> Zurovac D, Sudoi RK, et al. 2011. The effect of mobile phone text-message reminders on Kenyan health workers' adherence to malaria treatment guidelines: A cluster randomised trial. *Lancet*, 378: 795-803.

<sup>18</sup> *Call to action on global eHealth evaluation: consensus statement of the WHO Global eHealth Evaluation Meeting, Bellagio, September 2011*. Available at [http://www.ghdonline.org/uploads/The\\_Bellagio\\_eHealth\\_Evaluation\\_Call\\_to\\_Action-Release.docx](http://www.ghdonline.org/uploads/The_Bellagio_eHealth_Evaluation_Call_to_Action-Release.docx).

<sup>19</sup> Mitchell M, Hedt-Gauthier BL, et al. 2013. Using electronic technology to improve clinical care—Results from a before-after cluster trial to evaluate assessment and classification of sick children according to Integrated Management of Childhood Illness (IMCI) protocol in Tanzania. *BMC Med Informatics & Decision Making*, 13:95. Available at <http://www.biomedcentral.com/1472-6947/13/95>.

<sup>20</sup> UNICEF and World Health Organization. 2015. Countdown to 2015 maternal, newborn & child survival: A decade of tracking progress for maternal, newborn and child survival—The 2015 report. Available at [http://www.countdown2015mnch.org/documents/2015Report/Countdown\\_to\\_2015\\_final\\_report.pdf](http://www.countdown2015mnch.org/documents/2015Report/Countdown_to_2015_final_report.pdf).

<sup>21</sup> WHO. Malawi neonatal and child health country profile. Available at [http://www.who.int/maternal\\_child\\_adolescent/epidemiology/profiles/neonatal\\_child/mwi.pdf](http://www.who.int/maternal_child_adolescent/epidemiology/profiles/neonatal_child/mwi.pdf).

<sup>22</sup> Bjornstad, et al. 2014. Determining the quality of IMCI pneumonia care in Malawian children. *Paediatrics and International Child Health*, 34(1), 29-36.

<sup>23</sup> Nsona H, Mtimuni A, et al. 2012. Scaling up integrated community case management of childhood illness: Update from Malawi. *AMJTMH*, 87(5) supp: 54-60.

national iCCM protocol and guides HSAs through the assessment process to classify and recommend a treatment plan for each child. HSAs were trained on how to use the phones and the application. The data that are captured in HSA mobile phones are electronically submitted to a central database that D-tree hosts, which allows D-tree data program managers to review and follow up with HSAs who do not submit data, make errors, or experience difficulties with their phones. The application, therefore, has the potential to facilitate real-time access to and use of data for program decisions and to improve the quality of iCCM data. Furthermore, D-tree has established a helpline and short message service user group to ensure that user issues are addressed and resolved quickly. The mobile application was piloted in four of the RAcE districts: Dedza, Mzimba North, Ntcheu, and Ntchisi.

Save the Children, in partnership with D-tree, has engaged MOH and other potential stakeholders from districts outside the RAcE program areas through consultation meetings and training sessions to garner interest and support for scaling up the mHealth application. However, the application has not been formally evaluated to understand the value added and operational challenges, if any, when used in the iCCM program in Malawi. No evidence exists of how the use of the mobile application improves the quality of care that HSAs provide, compared to the care provided by HSAs using the standard iCCM paper guidelines, or how the quality of data generated through the mobile application compares to the quality of data generated through paper tools. Results from this evaluation will help to better understand the value added by the mobile application and to generate recommendations to ensure that the application is sustainable beyond the RAcE project.

## EVALUATION METHODS

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### Purpose and Objectives

The overall purpose of the study was to assess the value added of using the D-tree mobile application in iCCM programs for better quality of care delivered to children under five years of age and quality of data reported by HSAs. The study had the following objectives:

- **Quality of Care.** To compare the outcomes in the quality of care by HSAs using the D-tree mobile application, compared to HSAs using the paper forms, for the correct assessment, classification, and treatment in iCCM programs for children under five years of age.
- **Data Quality Assessment (DQA).** To compare the outcomes in the quality of data accuracy (captured through consistency), completeness, and availability of iCCM data that are collected and reported by HSAs using the D-tree mobile application, compared to HSAs using the paper forms system and to better understand data use for program decisions.
- **Facilitators and Barriers to the Use of the Mobile Application.** To identify and document factors that facilitate or impede the use of mobile technology in Malawi.

Under these objectives, the study addressed the following evaluation questions:

- **Quality of Care.** Does the use of the D-tree mobile application by HSAs improve the quality of care for children under five years of age, compared to children being classified and treated by HSAs who do not use this technology?
- **DQA.** How does the quality<sup>24</sup> of data, as defined by availability, completeness, and consistency (a measure of accuracy), recorded by HSAs using the mobile application and submitted to the D-tree database compare with the quality of data recorded by HSAs using paper registers and reported to facilities using paper forms?
- **Facilitators and Barriers to the Use of the Mobile Application.** What are the factors that facilitate or hinder implementation of the D-tree mobile application that will affect its adoption and scale-up for iCCM programs in other districts in Malawi and data use for program decisions?

### Study Design and Procedures

This cross-sectional, mixed-method study included quantitative and qualitative data collection comprised of three interlinked components:

- **Quality of Care.** A quasi-experimental study compared intervention and comparison groups to evaluate the effect of the iCCM mobile application on the adherence to iCCM guidelines by HSAs using the mobile application and paper versions of the protocol.
- **DQA.** A quasi-experimental study design included HSAs who use both the mobile application and paper forms to collect and report data to the D-tree database and to health facilities to evaluate the quality of data submitted through the two methods.
- **Qualitative Analysis.** Key informant interviews were conducted to collect qualitative data from stakeholders on their perceptions about quality of care, data quality, and data use when using the

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<sup>24</sup> Data quality consists of eight dimensions: accuracy, completeness, reliability, integrity, timeliness, confidentiality, precision, and availability of data (see *ICF DQA Guide: Adapted from MEASURE Evaluation. September 2008. Data Quality Audit Tool*). For this study, we assessed three dimensions: accuracy (captured through consistency), completeness, and availability of iCCM data.



mobile application in iCCM programs. The interviews helped provide context to the quantitative analysis (quality of care study and the DQA). The qualitative data were also used to understand the facilitators and barriers to the implementation of the mobile application in an iCCM program and data use for decision making, and to recommend ways to help improve and scale up the mobile application for iCCM in Malawi and beyond.

## Quality of Care

### Study Design

The study was a quasi-experimental design with intervention and comparison groups. The intervention group consisted of HSAs trained in iCCM who used the mobile application as a decision support tool for classifying and treating sick children. These HSAs worked in four of the RAcE districts: Dedza, Mzimba North, Ntcheu, and Ntchisi. The comparison group consisted of HSAs who received the same iCCM training but relied on the paper iCCM protocol to classify and treat sick children. These HSAs worked in the remaining three RAcE districts: Lilongwe, Nkhata Bay, and Rumphi.<sup>25</sup> HSAs in both intervention and comparison groups received RAcE-supported iCCM training according to national protocols, including training on the paper versions of the national iCCM data collection and reporting tools. The intervention group received an additional two-and-a-half days of training from D-tree on the use of the mobile application. The underlying assumption was that the districts in the intervention and comparison groups were identified in a similar manner by applying the MOH criteria to identify hard-to-reach areas for iCCM services, and that no differences existed in the criteria used to hire and place HSAs in the hard-to-reach areas across the intervention and comparison districts.

On the day the data collection team visited a village clinic, the first four children 2–59 months of age who presented to the HSA for an initial consultation on their current illness were eligible for inclusion in the study. Severely ill children who needed urgent referral to a health facility were excluded.

The data collection team consisted of observers—nurses with clinical training in child health and IMCI—and evaluators—trainers of the iCCM protocol who were MOH employees. Observers used a case observation checklist to observe the assessment, classification, and treatment of children under five years of age by HSAs using either the mobile application or paper form versions of the iCCM protocol. The checklist documented HSA adherence to the iCCM protocol. HSAs were advised to indicate their treatment of the illnesses as if no stockouts of the necessary drugs existed. To ease the burden on sick children and caregivers, the evaluators simultaneously observed the sick child assessment by using a re-examination form, and then used the assessment and any follow-up questions to independently classify and decide treatment for the child. The evaluator classification and treatment decisions were used as the gold standard to compare the HSA classifications and treatment decisions. Before any treatment, the HSA and the evaluator consulted to align classification and treatment determinations. In cases of discrepancies between the HSA and the evaluator, the evaluator classification and treatment prevailed.

A case observation checklist was developed based on existing tools from an HSA quality of care study that Save the Children conducted for RAcE Malawi in 2014 using the WHO Health Facility Survey Tool

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<sup>25</sup> Although six HSA were trained in iCCM in Likoma, they were not considered for inclusion in the control group. Likoma is a small island in the middle of Lake Malawi. The small number of HSA in this district was too low to warrant the added cost of travel to that district for data collection.



to Evaluate the Quality of Care Delivered to Sick Children Attending Outpatients Facilities (see Appendices 1 and 2). The tool was updated to match the current iCCM protocol specific to Malawi and adapted for this study. The study also included an HSA questionnaire to clarify and provide context for study findings (see Appendix 3).

### **Sample Size and Sample Selection**

The sampling frame included all trained and active HSAs working in seven RAcE districts—Dedza, Lilongwe, Mzimba North, Nkhata Bay, Ntcheu, Ntchisi, and Rumphu—from a list obtained from Save the Children officials. The sampling frames consisted of 493 HSAs in the intervention group and 306 HSAs in the comparison group.<sup>26</sup>

We anticipated that we would select 128 HSAs from the intervention and comparison groups using a stratified random sample, where health facilities were stratified according to the number of HSAs reporting to the facility. Facilities were selected randomly in their strata. Larger facilities—defined as facilities that supervise at least six HSAs—were sampled disproportionately, with approximately 75 percent of the selected facilities from the large stratum and 25 percent of the selected facilities from the small stratum. The intervention group included 37 health facilities (8 small and 29 large). The comparison group included 20 health facilities (5 small and 15 large). All HSAs from the sampled facilities were included. We expected to observe four sick children per HSA on the day of the data collection visit.

The sample size, with an expected 1,024 sick child observations, was calculated to detect an 11 percentage point difference in HSA adherence to the iCCM treatment protocol across the two groups, with 80 percent power and alpha of 0.05.<sup>27</sup> Sample size calculations accounted for a design effect of 1.75 due to repeat measures for each HSA; the design effect was calculated from an interclass coefficient of 0.25 with a cluster size of four sick child visits per HSA.<sup>28</sup> To allow for nonresponse or low-case load among some HSAs, we increased the sample by 3 percent in each group.

Before we visited the HSAs and sometimes during the sick child observations, we discovered that some HSAs were ineligible or unable to participate in the study because the HSA (1) was not using the mobile application to guide sick child visits, (2) did not have available paper versions of data for the data quality assessment, (3) was away at training, or (4) was not available because of a death or a transfer to an out-of-sample village health clinic. Of the HSAs initially sampled to participate in the study, barely half of the HSAs indicated that they used the mobile application for sick child visits. In total, 135 HSAs (130 from the intervention group and 5 from the comparison group) were replaced during data collection using random selection and the original sampling frame. The final study sample included 160 HSAs from the intervention group (128 who used the mobile application as a decision support tool for classifying and treating sick children and 32 who were not using the mobile application) and 132 HSAs from the comparison group. Data collectors included 32 HSAs from the intervention group who did not use the

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<sup>26</sup> The Khuwi health facility in Dedza was excluded from the sampling frame because HSAs reporting to the health facility were participating in a pilot of upgrades to the mobile application during the data collection period.

<sup>27</sup> Estimating treatment protocol adherence to be 73 percent among the treatment group and 62 percent among the control group, based on findings from a recent study conducted in Malawi. D-tree International, 2015. Evaluation Report of the Barr Foundation eCCM Project. Unpublished.

<sup>28</sup> Based on WHO guidance for observation studies as outlined in: Health Facility Survey: Tool to evaluate the quality of care delivered to sick children attending outpatient facilities. Geneva: Dept. of Child and Adolescent Health and Development, WHO, 2003.

mobile application during any sick child visits on the day of the data collection visit. Half of these HSAs (n=16) reported not using the mobile application during the past month to record sick children assessments because they found the mobile application time consuming or non-functioning; the mobile phone was lost, stolen, or non-functioning; or the mobile phone had inadequate battery power and there was a lack of electricity to charge. We included these 32 HSAs in the overall evaluation but excluded them from the robustness analysis to detect their influence, if any, on the findings.

## **Data Collection**

Fifteen teams collected data, and each team consisted of an evaluator and observer. Three coordinators and three supervisors, assigned by region, provided coordination, supervision, logistical support, and quality control. All individuals participated in a five-day training from August 22 to 26, 2016, to familiarize them with the study objectives and purpose, methodology, iCCM protocol, data collection instruments and techniques, quality assurance mechanisms, and study ethics.<sup>29</sup> For this component of the study, individuals practiced direct observation, clinical re-examination, and HSA interviews through role play and data collection simulation using iCCM training videos. Observers and evaluators achieved 80 percent concordance with gold standard results on two iCCM assessments using iCCM training videos that simulated assessment, classification, and treatment of a sick child. Data collection instruments and procedures were pretested and adapted to local conditions. Individuals were also trained on how to use tablet computers for data collection and practiced on the tablet computers during the role play and simulation exercises.

The survey was piloted in village clinics not included in the study to practice data collection under conditions that more closely resembled those of the actual survey. All teams, coordinators, and supervisors participated in the pilot.

Data collection began August 29 and continued over 25 working days. Evaluators did not collect data from the same village clinics where they normally work to minimize bias, particularly from influencing HSA behavior and performance. Most HSAs do not open their village health clinic every day and, consequently, they were informed of the date of the data collection visit to ensure their availability. Data collection teams arrived early in the morning and spent up to one day with each HSA observing the first four sick child visits of children 2–59 months of age and collecting data. In some instances, data collection teams returned to a village health clinic if no sick children sought care from the HSA on the day of the previous visit. Before the data collection began, the teams obtained written consent for participation in the study from the HSAs and caregivers of the sick children.

Data collectors entered data in the field using the tablet computers. All data were uploaded daily and checked for missing data and inconsistencies.

Primary data collection was complemented by secondary data from the Malawi Millennium Development Goals Endline Survey (MES) 2014 and the Malawi Demographic and Health Survey (MDHS) 2010<sup>30</sup> to control for district-level differences in infrastructure and in population that could influence the working conditions of the HSAs. The indicators included access to improved water source, electricity, and improved sanitation facilities; child mortality; exposure to mass media from MES and treatment-seeking

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<sup>29</sup> The training covered all aspects of the study, including the data quality assurance and facilitators and barriers components.

<sup>30</sup> An MDHS survey had recently been completed in February 2016, but district-level data had not yet been released.

for diarrhea, fever, and acute respiratory illness; and educational attainment and employment status of women—as a proxy for health-seeking behavior—from MDHS.

## **Data Analysis**

ICF conducted statistical analyses using weighted data to account for differential probabilities of selection and adjusted for clustering at the HSA level. We used descriptive statistics to summarize key population and HSA characteristics. We reported weighted percentages or means and 95 percent confidence intervals. Differences could exist between children, HSAs, and districts that influence the effect of the mobile application on quality of care. To isolate this effect, we used logistic regression and included child, HSA, and district-level characteristics as covariates. We then calculated predicted probabilities from the logistic regression for all outcomes of interest (or the probability of the outcome equaling one), which minimize any confounding factors that might result due to observable differences in child, HSA, or district-level characteristics. Appendix 4 lists outcome indicators. Covariates included gender and age of the child, gender and educational level of the HSA, tenure providing iCCM services as an HSA, type and duration since the last iCCM training, case load during the rainy season, village clinic location, access to an improved water source, and the median educational attainment of women. All continuous variables (i.e., age of child and HSA, tenure providing iCCM services as an HSA, duration since the last iCCM training, case load during the rainy season, and median educational attainment of women) are mean-centered to aid in interpretation. Some HSAs did not use the mobile application consistently across all sick child visits, and we conducted robustness analyses to exclude these observations.

Correlation between the infrastructure variables (access to improved water source and sanitation facilities and electricity) and also with child mortality precluded including all variables; thus only access to improved water source was used as the infrastructure variable. In retrospect, access to electricity may have been a better control because of the need to charge the mobile phones, but access to electricity varies widely between Lilongwe and the other districts. Our sample included HSAs employed in rural Lilongwe only, where electricity access is more limited and probably similar to the other districts. We also found a strong correlation between the educational level of women and the treatment-seeking behavior for common illnesses.

We restricted the sample to include only HSAs ( $n=137$  in the intervention group,  $n=113$  in the comparison group) and the corresponding sick children seen ( $n=987$ ) with non-missing data on each indicated covariate. The differences between the overall and restricted samples for both the HSA and sick children were not statistically significant. One exception was that a slightly larger percentage of HSAs in the restricted sample tended to have completed Form 4 (MSCE) (70.6 percent of HSAs in the overall sample, compared to 74.6 percent in the restricted sample [ $p=0.002$ ]). We used the Wald test to assess the comparability between the HSAs and children in the intervention and comparison groups. Two-tailed tests with  $p$ -values  $\leq 0.05$  indicated statistical significance. All analyses were conducted using Stata, version 14 (Stata Corp., College Station, TX, USA).

## **Data Quality Assessment**

### **Study Design**

The DQA component of the evaluation was a quasi-experimental study design that included the HSAs selected for the study in the four study intervention districts where both the mobile application and the

paper forms are used. The assessment compared data HSAs collected using the iCCM mobile application and submitted to the D-tree database to data collected by the same HSAs using village clinic registers and submitted to health facilities through monthly reporting forms for a two-month period (June–July 2016). This study design was deemed appropriate for measuring the degree of agreement between the data collected for the same HSA from the mobile application and the village clinic registers. Comparing quality of data collected by independent samples of HSAs in the intervention and comparison districts would not be meaningful. Thus, data collected by HSAs via paper forms and the mobile application in the intervention districts could be evaluated and compared because they were collected by the same HSA and thus should show agreement.

HSAs in the intervention districts captured iCCM data on both their mobile phone and paper registers at the point of service delivery (village clinic). The data collected through the mobile phone application were submitted directly to the D-tree database each time the HSA synced his or her phone to the system server. HSAs recorded the same data in their village clinic registers and then aggregated and reported the information in their monthly summary reporting forms, known as Form IA, to their supervisors at the facility level and then to the district, where the data are ultimately entered into the DHIS 2 database system.<sup>31</sup> On average, five village clinics report to a facility.

The DQA focused on three dimensions of data quality: data availability, completeness, and consistency (a measure of accuracy). Data availability was assessed in three sources for June–July 2016:

- **Village clinic register.** Data for an assessed month were considered available if there was at least one sick child visit entry recorded in an HSA’s register reviewed by the mHealth Evaluation Team.
- **Form IA.** Data for an assessed month were considered available if the reporting form was available for review by the mHealth Evaluation Team.
- **D-tree database.** Data for an assessed month were considered available if there was at least one sick child visit entry in the D-Tree database shared with the mHealth Evaluation Team.

Data availability was further assessed by examining the number of records in the village clinic registers and the D-tree database, and the total number of new cases in Form IAs for each HSA for the two months assessed. Data were considered “complete” if the reports or case management entries in the D-tree database and village clinic registers contained complete information in all fields by section of the form or entry for the two months assessed. Data were considered “consistent” if the data counts in the village clinic registers, Form IA, and the D-tree database were the same. Consistency was assessed for the number of sick children and four additional selected indicators: cases of positive malaria rapid diagnostic tests (mRDTs), diarrhoea, fast breathing, and referrals due to danger signs (see Appendix 5).

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<sup>31</sup> This study focuses only on the data reported to the facility level, but the process after Form IA is completed includes these actions: The HSA supervisor collates and summarizes the information from all Form IAs received from HSAs, associated with their facility in a monthly facility summary form known as Form IB. The facility in charge certifies the completed facility summary form and then submits it to the IMCI coordinator at the district level. At the district level, the IMCI coordinator, the health management information system officer, and the district RAcE monitoring and evaluation officer review and validate the data received from all facilities. After the data are validated, the information is entered in the web-based national DHIS2 database.

## **Sample Size and Sample Selection**

The DQA used the same sample of HSAs selected for the quality of care study in the intervention districts. One HSA, however, was excluded due to missing data for all the DQA components. This yielded a final study sample of 159 HSAs for the DQA.

## **Data Collection**

Data for the DQA were collected by the same two-person teams assigned to the intervention districts (Dedza, Mzimba North, Ntcheu, and Ntchisi) for the quality of care component of the study. The training for data collectors was conducted as previously described in the Quality of Care section. For the DQA component of the study, data collectors were specifically trained on the DQA methods, data tracking tools, procedures for reviewing records, and which information to extract from the HSA village clinic registers and monthly reporting forms. Before the visit to the village clinic, HSAs were requested to make their village clinic registers and their monthly summary forms available for review on a scheduled date. The teams visited the village clinics and reviewed the village clinic registers to extract the verified counts of cases of sick children treated, as recorded in the HSA village clinic registers, and the corresponding counts reported by HSAs in their monthly summary forms (Form 1A). The teams also collected information about village clinic register and Form 1A availability and completeness.

All data were collected using an assessment tool developed from the ICF RAcE DQA Excel tool, previously used in an external DQA that ICF conducted for RAcE Malawi in February 2016 (see Appendix 6). For the period assessed, the tool captured the following information for the village clinic registers and monthly summary forms: (1) availability; (2) completeness by register or form section; (3) total number of sick children seen; and (4) four selected indicators (cases of positive mRDT, fever, fast breathing, and diarrhea) and referrals with danger signs.

ICF provided D-tree with the sample of HSAs used in the study. D-tree, in turn, provided ICF with the corresponding HSA IDs and the sick child assessment and patient background information data in the database for June and July 2016. ICF then used the D-tree HSA IDs to extract the sick child assessment data by HSA included in the DQA component of the study, which were compared to the data obtained from the paper forms.

## **Data Analysis**

As with the quality of care component, we conducted a statistical analysis for the DQA component using weighted data to account for differential probabilities of selection and adjusted for clustering at the HSA level. Weighted percentages or means and 95 percent confidence intervals are reported for availability, completeness, and consistency measures. All analyses were conducted using Stata, version 14 (Stata Corp., College Station, TX, USA).

## **Qualitative Analysis**

### **Sample Selection and Data Collection**

The qualitative component of the study used key informant interviews to collect data from stakeholders representing all levels of the iCCM implementation system (national, district, facility, village clinic, and beneficiary levels) on context and their perspectives on facilitators and barriers to the roll-out of the mobile application and its effects on the quality of care, data quality, and use of iCCM data for decision making. We conducted 47 key informant interviews with the national IMCI coordinator, an IMCI

monitoring and evaluation (M&E) officer, two D-tree staff members, the Save the Children M&E staff member, the district IMCI and RAcE program coordinators from all seven RAcE districts, and two senior HSAs (SHSAs) and two caregivers per district. Similar questions were incorporated into the HSA questionnaire to capture their perspectives as well. The SHSAs and caregivers were selected randomly using a systematic approach. To select SHSAs for interviews, two facilities in each district were randomly selected from facilities included in the study, and the SHSA who reported to each selected facility was interviewed. If more than one SHSA reported to a selected facility, one was selected at random for the interview during the site visit. One HSA was selected randomly from each of the two selected facilities in each district, and then, on the day of the village clinic visit, one caregiver with a sick child was selected randomly for interview at the end of his or her consultation with the HSA (see Table 1).

**Table 1: Key Informant Interview Subjects**

Level	Role of Interviewee	iCCM Mobile Application Districts	Paper Tool Districts
Caregivers	Select caregivers of sick children	8	6
Village Clinic	All HSAs in the study	159	132
Facility	Senior HSA	8	6
District	District Coordinator and RAcE Program Manager	8	6
National	<ul style="list-style-type: none"> <li>▪ Ministry of Health</li> <li>▪ Head of the IMCI Program</li> <li>▪ M&amp;E Specialist</li> <li>▪ Save the Children</li> <li>▪ Program Coordinator</li> <li>▪ D-tree</li> <li>▪ Country Director</li> <li>▪ Technical Coordinator</li> </ul>		

ICF developed key informant interview guides for questions on the quality of care and the DQA components for the different levels of stakeholders. Interview guides for caregivers were developed in English (see Appendix 7) and then translated into Chichewa (see Appendix 8). Interview guides for other stakeholders were developed in English (see Appendices 9–14). We reviewed and revised these guides during the training to clarify the local context and vernacular. ICF staff conducted all national-level interviews, and the data collecting teams conducted interviews with district- and facility-level staff and caregivers during the fieldwork visits.

### **Data Analysis**

All qualitative interview data were entered and analysed using ATLAS.ti. The data were organized and analyzed by level: national, district, facility, village clinic, and caregiver. We conducted thematic analysis of the key informant interview responses for perceptions about using the mobile application, compared to paper forms, as a decision support tool during sick child assessments and for data recording, reporting, accessing, and use from both reporting systems for program improvement. We also analyzed the qualitative data specifically to identify the facilitators and barriers to using the iCCM mobile application.

## Ethical Approval

ICF obtained ethical approval from the Institutional Review Boards of ICF and the Malawi MOH National Health Sciences Research Committee.

## RESULTS

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The evaluation results are presented according to the study evaluation questions.

### **Does the use of the D-tree mobile application by HSAs improve the quality of care of children under five years of age, compared to children being classified and treated by HSAs not using this technology?**

#### **Description of the Sample of HSAs**

Table 2 lists the HSA characteristics for the intervention and comparison districts. HSAs in the intervention and comparison districts tended to be similar in the following: age, late 30s; educational level, more than 70 percent completed Form 4 (MSCE); tenure providing iCCM services, 5 years; and residence in the village clinic catchment area, more than 75 percent. The table also includes information on HSA case load, operating hours of the village clinic, and drug supplies. HSAs in the intervention districts were less likely to be male (64.9 percent in the intervention districts, compared to 85.3 percent in the comparison districts) and to have the village clinic not located in or adjacent to their home (54.6 percent intervention districts, compared 80 percent comparison districts). Almost 80 percent of the HSAs in the intervention districts relied on the iCCM mobile application to guide the sick visit. All HSAs in the comparison districts used the village clinic register, which was designed primarily for reporting, to guide the sick visit. Note that 32 HSAs in the intervention districts did not use the mobile application for any of the sick child visits. Some HSAs also used the mobile application inconsistently across the observed four sick child visits. HSAs depended less on the sick child recording form, a job aide with an algorithm adapted from the WHO iCCM I case management protocol. This was not surprising for the HSAs who used the mobile application, which imbeds the IMCI guidelines, but it was not expected that less than half of the HSAs in the comparison group would use the sick child recording form. The difference between HSAs in the intervention and comparison was not statistically significant for training, supervision, or mentoring visits to the health facility. The one exception was that more HSAs in the intervention group (34 percent) had the initial training than HSAs in the comparison group (11 percent). The initial training tends to be more rigorous and complete than refresher trainings that tend to focus on specific areas of iCCM case management.



**Table 2: Comparison of HSA Characteristics in Districts Using the iCCM Mobile Application and Paper Tools**

Characteristics	iCCM Application (N=137)		Paper Tools (N=113)		p-value
	Weighted %	(95% CI)	Weighted %	(95% CI)	
Age—years (mean)	36.0	(33.8, 38.2)	38.0	(37.0, 39.0)	0.1131
Gender					
Female	35.1	(19.0, 55.5)	14.7	(7.6, 26.6)	<b>0.0415</b>
Male	64.9	(44.5, 81.0)	85.3	(73.4, 92.4)	
Highest level of education completed					
At most Form 2	24.4	(13.4, 40.4)	26.5	(15.7, 41.1)	0.8276
Form 4 (MSCE)	75.6	(59.6, 86.6)	73.5	(58.9, 84.3)	
Years providing iCCM services as HSA (mean)	5.4	(4.3, 6.6)	4.7	(4.2, 5.2)	0.2727
Lives in village clinic catchment area	76.4	(59.3, 87.8)	77.3	(57.2, 89.7)	0.9304
Sick children seen per day (mean)					
Rainy season	16.3	(12.1, 20.6)	19.1	(14.9, 23.2)	0.3608
Dry season	9.1	(6.9, 11.3)	10.0	(7.6, 12.4)	0.5920
Village clinic located in room not attached or not next to home	54.6	(38.8, 69.4)	80.0	(70.3, 87.1)	<b>0.0066</b>
Days in past 7 days operate village clinic (mean)	3.5	(2.7, 4.4)	3.5	(2.5, 4.5)	0.9301
Hours in past 7 days operate village clinic (mean)	30.6	(21.6, 39.6)	32.3	(8.2, 56.3)	0.8962
Primary iCCM protocol used <sup>a</sup>					
Sick child recording form	16.8	(9.6, 27.8)	46.9	(20.6, 75.0)	<b>0.0389</b>
Village clinic register	60.1	(39.8, 77.4)	100.0	(100.0, 100.0)	
iCCM mobile application	79.1	(63.4, 89.2)	0.0	(0.0, 0.0)	<b>0.0000</b>
Items currently included in drug box <sup>b</sup>	9.2	(8.7, 9.6)	8.9	(8.5, 9.3)	0.3494
Items stockout that lasted 7 days or more <sup>c</sup>	1.7	(1.1, 2.2)	2.0	(1.4, 2.7)	0.3581
<b>Training, Supervision, and Mentoring</b>					
Most recent iCCM training					
Initial	34.0	(16.8, 56.9)	11.7	(5.5, 23.1)	<b>0.0342</b>
Refresher	66.0	(43.1, 83.2)	88.3	(76.9, 94.5)	
Months since most recent iCCM training (median (interquartile range))	4.4	(2.4, 18.4)	2.4	(2.4, 15.4)	0.5084
Tools trained on in most recent iCCM training (mean) <sup>d</sup>	2.9	(2.9, 3.0)	2.9	(2.9, 3.0)	0.9805
Days report to health facility in past month (mean)	5.8	(4.8, 6.8)	7.1	(5.5, 8.6)	0.1700
Supervisory visits in past 3 months (mean)	1.2	(1.0, 1.3)	1.0	(0.8, 1.3)	0.3297
Most recent supervisory visit by senior HSA	69.5	(47.4, 85.2)	60.1	(41.0, 76.5)	0.4936
Tasks conducted during most recent supervisory visit (mean) <sup>e</sup>	5.6	(5.2, 6.1)	4.7	(3.6, 5.8)	0.1383
Mentor visits in past 3 months (mean)	0.8	(0.6, 1.1)	0.7	(0.3, 1.0)	0.4334
Tasks conducted during most recent mentor visit (mean) <sup>f</sup>	3.0	(2.2, 3.8)	2.0	(1.0, 3.1)	0.1598

Notes:

<sup>a</sup> Categories are not mutually exclusive because HSA may use multiple guides.

<sup>b</sup> Drug box should include 11 items: LA (1x6 and 2x6 blister packets), rapid diagnostic test, rectal artesunate, amoxicillin/cotrimoxazole, oral rehydration solution, zinc, paracetamol, eye antibiotic, timer, and gloves.

<sup>c</sup> Nine items included for stockout: LA (1x6 and 2x6 blister packets), rapid diagnostic test, rectal artesunate, amoxicillin, oral rehydration solution, zinc, paracetamol, and eye antibiotic.

<sup>d</sup> The tools include sick child recording form, village clinic register, and referral slip.

<sup>e</sup> Seven possible tasks are included: reviewing village clinic register, checking supplies and equipment levels, using a supervision checklist, administering a case scenario, observing management of a sick child, meeting with village committee members, and giving feedback on iCCM activities.

<sup>f</sup> Four possible tasks are included: using a mentoring checklist, observing management of a sick child, demonstrating how to care for a sick child or identify danger signs, and giving feedback on case management skills.

## Description of the Sample of Sick Children

During the sick child visit, HSAs initially asked caregivers for the primary reasons for the visit; children may have presented with multiple reasons. Table 3 compares the characteristics of sick children seen by HSAs and the presenting complaints of the caregivers according to whether the HSA used the iCCM mobile application or the paper tools. Sick children in both groups were similar in age and gender distribution. Differences exist in care-seeking behavior of caregivers as indicated by statistically significant differences in presenting complaints.

**Table 3: Characteristics and Presenting Complaints of Observed Sick Children Seen by HSAs in Districts Using the iCCM Mobile Application and Paper Tools**

	iCCM Mobile Application (N=535)		Paper Tools (N=452)		
	Weighted		Weighted		
Characteristics	%	(95% CI)	%	(95% CI)	p-value
Age—years (mean)	23.5	(21.1, 25.8)	23.3	(21.5, 25.2)	0.9434
Gender					
Female	53.2	(46.0, 60.4)	58.1	(51.0, 64.9)	0.3474
Male	46.8	(39.6, 54.0)	41.9	(35.1, 49.0)	
Presenting complaint of observed sick children as reported by caregiver					
Cough	69.1	(62.4, 75.1)	62.9	(55.7, 69.6)	0.2003
Fever	61.5	(56.0, 66.8)	65.2	(57.9, 71.9)	0.4208
Diarrhea	20.9	(15.9, 26.9)	30.3	(23.5, 38.0)	<b>0.0426</b>
Vomiting	12.4	(8.2, 18.5)	13.3	(8.4, 20.3)	0.8367
Other problem mentioned	12.1	(7.6, 18.6)	9.3	(5.7, 14.9)	0.4410
Red eyes	6.2	(3.6, 10.5)	3.9	(1.7, 8.6)	0.3503
Difficulty drinking or feeding	3.6	(1.5, 8.6)	2.5	(1.0, 6.1)	0.5747
Malaria	1.0	(0.2, 6.0)	7.6	(4.9, 11.5)	<b>0.0298</b>
Fast or difficult breathing	0.7	(0.3, 1.5)	6.4	(3.4, 11.8)	<b>0.0000</b>
Pneumonia	0.1	(0.0, 0.7)	5.2	(2.7, 9.9)	<b>0.0002</b>
Convulsions	0.1	(0.0, 0.7)	0.3	(0.1, 1.0)	0.3073
Sleepy or unconscious	0.0	(0.0, 0.0)	0.9	(0.5, 1.6)	<b>0.0020</b>

Despite differences in presenting complaints, no statistically significant differences existed between sick children in the intervention and comparison districts for the majority of how illnesses were classified, based on the gold standard of the evaluator (see Table 4). Children in the intervention districts were more likely to have red eye for more than four days and less likely to exhibit some signs of malnutrition indicated by yellow on the middle upper arm circumference (MUAC) tape, compared to the comparison districts. Hence, children were no sicker in the intervention districts as compared to the comparison districts.

**Table 4: Classification of Observed Sick Children Seen by HSAs in Districts Using the iCCM Mobile Application and Paper Tools, Based on Gold Standard Re-examination**

Characteristics	iCCM Mobile Application (N=535)		Paper Tools (N=452)		p-value
	Weighted %	(95% CI)	Weighted %	(95% CI)	
Cough with fast breathing	21.5	(15.7, 28.8)	21.7	(15.3, 29.7)	0.9797
Fever					
Less than 7 days	67.1	(61.6, 72.1)	70.8	(64.6, 76.3)	0.3562
7 days or more	1.3	(0.3, 5.3)	3.0	(1.3, 6.9)	0.3189
Diarrhoea					
Less than 14 days and no blood in stool	21.0	(16.2, 26.7)	28.1	(21.7, 35.5)	0.1077
14 days or more	0.7	(0.3, 1.5)	0.1	(0.0, 0.8)	0.0810
Blood in stool	2.1	(0.8, 5.3)	2.8	(0.9, 8.2)	0.6940
Red eyes					
Less than 4 days	5.1	(2.6, 9.6)	5.9	(2.9, 11.4)	0.7636
4 days or more	2.3	(1.0, 5.3)	0.5	(0.2, 1.2)	<b>0.0150</b>
Visual problem	0.0	(0.0, 0.0)	0.1	(0.0, 0.8)	0.3176
Chest indrawing	1.9	(0.7, 5.2)	1.7	(0.5, 6.0)	0.8997
Vomits everything	1.1	(0.2, 5.7)	0.3	(0.1, 1.0)	0.2188
Palmar pallor	0.3	(0.1, 0.9)	0.2	(0.1, 0.9)	0.7220
MUAC tape					
Red	0.3	(0.1, 0.9)	0.3	(0.1, 1.0)	0.9214
Yellow	0.3	(0.1, 0.9)	3.0	(1.1, 8.2)	<b>0.0029</b>
Convulsions	0.1	(0.0, 0.7)	0.4	(0.2, 1.2)	0.1897
Not able to drink or feed anything	0.1	(0.0, 0.7)	0.3	(0.1, 1.0)	0.3073
Very sleepy or unconscious	0.0	(0.0, 0.0)	0.1	(0.0, 0.8)	0.3176
Swelling of both feet	0.0	(0.0, 0.0)	1.2	(0.2, 7.0)	0.2745
Other problems, refer	12.3	(7.9, 18.7)	11.4	(7.3, 17.4)	0.7995

## Assessment

HSAs using the iCCM mobile application tended to assess sick children according to the iCCM protocol more often than HSAs in the comparison group (see Table 5). In particular, a statistically significant higher percentage of children seen by HSAs in the intervention group were assessed for cough, diarrhoea, for the three general danger signs, and for the five physical danger signs. HSAs in the intervention group were more likely to check the child for the ability to drink or eat and for convulsions. Our analysis found no statistically significant difference between the intervention and comparison groups for checking for vomiting. HSAs in the intervention group were also more likely to assess for all of the components of the physical danger signs, with the exception of checking if the child was red on the MUAC tape. Although the rate that the intervention group checked was higher, the difference for this component was not statistically significant. The differences between the intervention and comparison groups for children assessed for malaria with rapid diagnostic tests and fever were not statistically significant. After the HSA indicates that a child has a cough, the mobile application prompts the HSA to count the child's respiratory rate; the paper forms have a section in which the HSA enters the number of breaths if cough is identified. The mobile application also includes a stopwatch to facilitate the counting of respiratory rates. Despite this prompt and easier access to a stopwatch through the mobile application, HSAs in both the intervention and comparison groups had similar assessment rates for fast breathing through counting of respiratory rates, and they also had similar counts of respiratory rates, compared to the gold standard evaluator.<sup>32</sup>

<sup>32</sup> Restricting the intervention group to include only those HSAs who used the mobile application during the sick child visit (n=128), yielded similar results, except the assessment of children with cough and fast breathing by counting respiratory rates,

**Table 5: Predicted Probabilities of the Correct Assessment for Illnesses of Observed Sick Children Seen by HSAs in Districts Using the iCCM Mobile Application and Paper Tools (N=987)**

Symptoms	iCCM Mobile Application		Paper Tools		p-value
	Weighted %	(95% CI)	Weighted %	(95% CI)	
Children checked for presence of cough	97.9	(96.6, 99.2)	90.7	(85.5, 95.9)	<b>0.0007</b>
Children checked for presence of diarrhea	93.9	(90.8, 96.9)	87.4	(82.1, 92.6)	<b>0.0255</b>
Children checked for presence of fever	96.7	(94.4, 99.0)	92.6	(87.6, 97.6)	0.0556
Children with cough assessed for presence of fast breathing through counting of respiratory rates (N=716)	97.1	(94.3, 99.8)	95.7	(92.6, 98.9)	0.4625
Children with cough assessed for the presence of fast breathing in which HSA counted respiratory rate within +/- 3 breaths of gold standard (N=699)	84.8	(81.3, 88.3)	86.6	(82.2, 91.0)	0.4881
Children with fever assessed for malaria with rapid diagnostic test (N=652)	83.8	(73.3, 94.2)	88.6	(81.9, 95.3)	0.5072
Children assessed for three general danger signs	87.6	(83.6, 91.6)	78.6	(73.3, 84.0)	<b>0.0093</b>
Children checked if able to drink or eat anything	94.9	(92.9, 97.0)	89.4	(86.0, 92.9)	<b>0.0000</b>
Children checked if vomit everything	94.1	(90.7, 97.6)	91.1	(86.9, 95.4)	0.2696
Children checked if have convulsions	92.8	(90.7, 94.8)	84.0	(80.1, 87.9)	<b>0.0000</b>
Children assessed for five physical danger signs	79.9	(75.9, 84.0)	61.7	(55.0, 68.4)	<b>0.0000</b>
Children checked for chest indrawing	94.6	(92.8, 96.3)	78.2	(73.5, 82.9)	<b>0.0000</b>
Children checked if sleepy or unconscious	98.6	(97.0, 100.1)	96.5	(93.6, 99.5)	<b>0.0001</b>
Children checked for palmar pallor	99.1	(98.5, 99.8)	89.6	(84.6, 94.6)	<b>0.0000</b>
Children checked for malnutrition with MUAC tape	86.3	(82.9, 89.7)	82.6	(77.6, 87.6)	0.1823
Children checked if swelling of both feet	96.6	(95.0, 98.2)	85.9	(80.9, 91.0)	<b>0.0000</b>

Notes: Probabilities adjusted for child characteristics (age and gender), HSA characteristics (gender, highest education level, tenure as an HSA, type and duration since most recent iCCM training, patient case load, and village clinic location), and district characteristics (access to improved water source and median number of years of women's education) using logistic regression with standard errors clustered at the HSA level.

## Classification

Table 6 lists the concordance in the illness classification between the HSAs and the gold standard examination by the evaluator. More than 80 percent of HSAs using the iCCM mobile application classified sick children across the common illnesses and danger signs the same as the evaluator, compared to 57.6 percent of the comparison group. Classification of illnesses that HSAs can treat, specifically fever for less than seven days and classification of a child as green on the MUAC tape, account for this discrepancy.<sup>33</sup> HSAs, especially those using paper-based tools, tended to misclassify non-febrile children as having fever and failed to properly classify nourished children as falling into any color category. HSAs in both groups performed equally on the classifications of only the three main illnesses targeted through iCCM: malaria, diagnosed by a positive mRDT; diarrhoea; and cough with fast breathing. . No statistically significant differences were found between the two groups of HSAs for the

which was not significantly different between the groups. The reduction in sample size may have diluted the power to detect statistical significance between the groups.

<sup>33</sup> We further analyzed whether differences in the assessment of the general and physical danger signs translated into differences in classification between the HSAs using the mobile application as compared to those using paper-based tools. Sub-analysis on only those who correctly assessed the general and physical danger signs yielded similar results.

individual illnesses, although the concordance of classification between HSAs in the intervention group and the gold standard evaluator tended to be higher than HSAs in the comparison group.<sup>34</sup>

**Table 6: Predicted Probabilities of the Correct Classification of Illnesses of Observed Sick Children Seen by HSAs in Districts Using the iCCM Mobile Application and Paper Tools (N=987)**

Classification	iCCM Mobile Application		Paper Tools		p-value
	Weighted %	(95% CI)	Weighted %	(95% CI)	
Children whose classifications given by HSA match all classifications given by evaluator <sup>a</sup>	80.7	(76.4, 84.9)	57.6	(49.6, 65.6)	<b>0.0000</b>
Children classified by HSA in the three common illnesses (malaria [positive mRDT], diarrhoea, and cough with fast breathing) that match the evaluator classifications	91.3	(87.6, 95.0)	82.5	(75.3, 89.8)	<b>0.0252</b>
Malaria (positive mRDT)	99.7	(99.1, 100.0)	99.9	(99.8, 100.0)	0.3924
Diarrhoea	95.7	(93.2, 98.2)	91.4	(86.3, 96.5)	0.0951
Cough with fast breathing	95.6	(92.9, 98.4)	89.2	(82.1, 96.2)	0.0550

Notes: Probabilities are adjusted for child characteristics (age and gender), HSA characteristics (gender, highest education level, tenure as an HSA, type and duration since most recent iCCM training, patient case load, and village clinic location), and district characteristics (access to improved water source and median number of years of women's education) using logistic regression with standard errors clustered at the HSA level.

<sup>a</sup> Classifications include diarrhea, cough, fever, fast breathing, blood in stool, chest indrawing, convulsions, not eating or drinking, vomiting everything, red eye, red eye with visual problems, sleepy or unconscious, palmar pallor, foot swelling, and color on the MUAC tape.

## Treatment, Referral, and Counseling

Table 7 lists the results of sick children correctly treated (i.e., correct quantity of drugs suggested as treatment) for each illness, compared to the percentage of children treated according to the gold standard evaluator. Overall, children with malaria, diarrhoea, or cough and fast breathing received the correct treatment for their illnesses, regardless of the tool—mobile application or paper—used to guide treatment. We investigated the effects of use of the mobile application separately on each illness. HSAs in the intervention group tended to prescribe an antimalarial drug correctly to children with fever and positive mRDT more often (80 percent) than HSAs in the comparison group (51.8 percent). Further investigation indicated no differences in treatment rates due to age band mixing, but differences were found in rates of offering any treatment. Of those HSAs incorrectly treating malaria, 66.5 percent (62.4 percent in comparison districts and 4.1 percent in intervention districts) failed to offer any treatment despite positive mRDT. HSAs had been instructed to recommend a treatment plan as if no drug shortages existed. The percentage of HSAs using paper tools was slightly higher than the percentage of HSAs using the mobile application for cases of children presenting with diarrhoea who were correctly prescribed zinc and oral rehydration solution (ORS) and for cases of children presenting with cough and fast breathing who were correctly prescribed an antibiotic. These differences, however, were not statistically significant. Few (less than 3 percent) of the HSAs in both groups would have treated children who were not classified with cough and fast breathing with an antibiotic. HSAs in the intervention group

<sup>34</sup> Results were similar when the intervention group included only HSAs who used the mobile application during sick child visits. The difference was not statistically significant for the correct diagnosis of the three common illnesses. The decline in sample size may have diluted the power to detect statistical significance between the groups.

who classified children as having one or more danger signs tended to then refer these children to the nearest health facility more frequently (87 percent) than HSAs in the comparison group (70.8 percent).<sup>35</sup>

**Table 7: Predicted Probabilities of the Correct Treatment and Referral of Children Seen by HSAs in Districts Using the iCCM Mobile Application and Paper Tools**

Treatment/Referral	N	iCCM Mobile Application	Paper Tools		p-value	
		Weighted %	(95% CI)	Weighted %		(95% CI)
Treatment						
Children with cough and fast breathing, positive mRDT, or diarrhoea who are correctly prescribed all medications (antibiotic, antimalarial drug, or ORS and zinc) for their illnesses	409	69.9	(62.5, 77.4)	64.7	(58.8, 70.6)	0.2674
Children with cough and fast breathing who are prescribed an antibiotic correctly	126	70.8	(67.9, 73.8)	74.6	(71.1, 78.2)	0.1474
Children with fever and positive mRDT who are prescribed an antimalarial drug correctly	169	80.0	(75.6, 84.5)	51.8	(47.0, 56.7)	0.0000
Children with diarrhoea who are prescribed ORS and zinc correctly	184	66.8	(56.2, 77.5)	68.7	(60.1, 77.3)	0.7601
Children without cough and fast breathing who would have left the HSA without having received an antibiotic	646	97.3	(94.3,100.0)	98.2	(96.2, 100.0)	0.5605
Referral						
Children with danger signs needing referral who are referred	184	87.0	(83.9, 90.1)	70.8	(57.0, 84.6)	0.0102
Counseling						
Children who need an antibiotic, ORS and zinc, or antimalarial drug who receive the correct first dose in presence of HSA	409	28.5	(18.2, 38.9)	35.5	(25.6, 45.3)	0.3738

Notes: HSAs prescribed antimalarial drugs for less than 0.5 percent of children with fever and negative mRDT. Probabilities adjusted for child characteristics (age and gender), HSA characteristics (gender, highest education level, tenure as an HSA, type and duration since most recent iCCM training, patient case load, and village clinic location), and district characteristics (access to improved water source and median number of years of women's education) using logistic regression with standard errors clustered at the HSA level.

To assess whether caregivers received counseling on the correct administration of drugs, we focused on whether the HSA encouraged the caregiver to give the first dose of treatment to the child in his or her presence. Less than 40 percent of the children treated by HSAs in either group received their first dose of treatment at the village clinic (see Table 7).<sup>36</sup> This low rate prompted us to explore whether this was remedied by HSAs counseling the caregiver on dosage, frequency, and duration of administering treatments; demonstrating treatment; and requiring caregivers to repeat the instructions for the

<sup>35</sup> Results were similar when the intervention group included only HSAs who used the mobile application during sick child visits. The difference was statistically significant for HSAs using the mobile application who were likely to prescribe an antibiotic correctly to children with cough and fast breathing (53.7 percent intervention group, compared to 77.6 percent non-intervention group).

<sup>36</sup> Drug stockouts do not account for the low rate of counseling on the correct administration of drugs. Observers indicated whether the drugs required for treatment were unavailable, and few HSAs experienced stockouts in antibiotics (0.3 percent), ORS (0.1 percent), and zinc (1.1 percent), or antimalarial drugs (0 percent) that were required for treatment of the sick child.



treatment procedure (see Table 8). Fewer than half of all HSAs counseled caregivers of children with the three common illnesses, and this difference was not statistically different between the two groups. The smallest percentage of HSAs counseled caregivers on diarrhoea treatment, with only 5.4 percent of HSAs using the mobile application providing counseling and 23 percent of HSAs using paper tools providing counseling. This discrepancy resulted from confusion about the frequency with which children should be given ORS. Few HSAs indicated that ORS should be given to children after each bout of diarrhoea. The difference between the groups for the other two illnesses was not statistically significant.

**Table 8: Predicted Probabilities of Caregiver Counseling (Explanation, Demonstration, and Repetition of Treatment) by HSAs by Districts Using the iCCM Mobile Application and Paper Tools**

Treatment/Referral	N	iCCM Mobile Application		Paper Tools		p-value
		Weighted %	(95% CI)	Weighted %	(95% CI)	
Caregivers of children with cough and fast breathing, positive mRDT, or diarrhoea who are counseled on their illnesses	437	29.0	(19.6, 38.4)	46.4	(33.3, 59.6)	0.0579
Cough and fast breathing	140	58.7	(53.1, 64.2)	65.0	(60.2, 69.8)	0.1554
Diarrhoea	203	5.4	(2.4, 8.3)	23.0	(8.0, 38.0)	<b>0.0138</b>
Fever and positive mRDT	176	57.2	(47.2, 67.2)	64.7	(51.3, 78.2)	0.3743

Notes: Probabilities adjusted for child characteristics (age and gender), HSA characteristics (gender, highest education level, tenure as an HSA, type and duration since most recent iCCM training, patient case load, and village clinic location), and district characteristics (access to improved water source and median number of years of women's education) using logistic regression with standard errors clustered at the HSA level.

## Characteristics of HSAs Achieving Concordance with the Gold Standard Evaluator on Treatment of All Illnesses and Danger Signs

Table 9 lists the characteristics of HSAs who correctly prescribed treatment for the three common illnesses. This analysis combines all HSAs, regardless of the guide used during sick child visits. Lower odds of correctly treating sick children were associated with male HSAs seeing more than 18 children per day on average. HSAs who have provided iCCM services for more than 5.1 years and HSAs who have received their most recent training as a refresher training both were negatively associated with the correct treatment of children. This suggests that HSAs who more recently started to provide iCCM services, and hence had the initial training as their most recent training, tended to treat children correctly. On the other hand, HSAs who had at least completed Form 4 were positively associated with correct treatment. Increased visits to the mentor, but not necessarily by the supervisor, was associated with improved odds of correct treatment; however, no association was found between correct treatment and the number of tasks the mentor conducted. Surprisingly, drug stockouts lasting at least seven days were positively associated with correct treatment. This result was sensitive to the inclusion of the 2x6 LA blister pack in the items stocked out and more so for HSAs using paper tools. More than a third of the HSAs who use paper tools reported missing this blister pack for seven days or more, compared to only 14.4 percent of HSAs who use the mobile application.

**Table 9: Characteristics of HSAs who Correctly Prescribed Treatment of Cough and Fast Breathing, Malaria, and Diarrhoea (N=409)**

Characteristics	Odds Ratio	(95% CI)	p-value
Gender			
Female	Ref		
Male	0.29	(0.16, 0.54)	<b>0.0001</b>
Highest level of education completed			
At most, Form 2	Ref		
Form 4 (MSCE)	3.64	(1.99, 6.64)	<b>0.0000</b>
Years providing iCCM services as HSA	0.92	(0.85, 0.99)	<b>0.0222</b>
Sick children seen per day	0.96	(0.95, 0.98)	<b>0.0001</b>
Village clinic located in room not attached to or next to home	0.84	(0.55, 1.30)	0.4350
Items currently included in drug box <sup>a</sup>	0.91	(0.67, 1.23)	0.5267
Items stockout that lasted seven days or more <sup>b</sup>	1.25	(1.08, 1.44)	<b>0.0036</b>
<b>Training, Supervision, and Mentoring</b>			
Most recent iCCM training			
Initial	Ref		
Refresher	0.31	(0.18, 0.55)	<b>0.0001</b>
Months since most recent iCCM training	1.00	(0.98, 1.01)	0.4052
Supervisory visits in past three months	1.16	(0.83, 1.61)	0.3803
Tasks conducted during most recent supervisory visit <sup>c</sup>	1.11	(1.00, 1.23)	0.0574
Mentor visits in past three months	1.73	(1.16, 2.59)	<b>0.0079</b>
Tasks conducted during most recent mentor visit (mean) <sup>d</sup>	0.81	(0.66, 1.01)	0.0612

Notes: Logistic regressions, clustered by HSAs and including child and district-level covariates, conducted separately for HSAs using the iCCM mobile application and HSAs using paper tools. Variable centered at the following overall means: years providing iCCM services (5.1 years), duration since most recent iCCM training (15.2 months), and number of sick children seen per day (17.6 children).

<sup>a</sup> Drug box should include 11 items: LA (1x6 and 2x6) blister packets, rapid diagnostic test, rectal artesunate, amoxicillin/cotrimoxazole, ORS, zinc, paracetamol, eye antibiotic, timer, and gloves.

<sup>b</sup> Includes nine items: LA (1x6 and 2x6) blister packets, rapid diagnostic test, rectal artesunate, amoxicillin, ORS, zinc, paracetamol, and eye antibiotic.

<sup>c</sup> Includes seven tasks: reviewing village clinic register, checking supplies and equipment levels, using a supervision checklist, administering a case scenario, observing management of a sick child, meeting with village committee members, and giving feedback on iCCM activities.

<sup>d</sup> Includes four tasks: using a mentoring checklist, observing management of a sick child, demonstrating how to care for a sick child or identify danger signs, and giving feedback on case management skills.

**How does the quality of data, as defined by availability, completeness, and consistency (a measure of accuracy), recorded by HSAs using the mobile application and submitted to the D-tree database compare with the quality of data recorded by HSAs using paper registers and reported using paper forms to facilities?**

## Availability

Data availability results show that data collectors were able to access and review the village clinic registers and monthly reporting forms for at least one of the two months for almost all HSAs included in the assessment. However, mobile application data in the D-tree database were not accessible to the data collectors for review in the field; the data were shared separately with the mHealth Evaluation Team via Excel files. The inaccessibility of the mobile data to stakeholders was reinforced by the qualitative study about key stakeholder perspectives on whether data reported using the mobile application to the D-tree database had facilitated their use for decision making. Several informants interviewed for this study at various levels, including HSAs, felt that the use of the mobile application



had not facilitated the use of data for decision making in their work. The following are some examples of the issues that emerged through this study:

- Some stakeholders, including SHSAs at the facility and district levels, said that they have not seen the D-tree dashboard. They also said that they have heard that currently D-tree is migrating their database to a different platform that will be more easily accessible, which will allow data to be downloaded and analyzed for decision making.
- During data collection for this evaluation study, the data collectors were not able to access the D-tree database to extract and review the data. Furthermore, it took a long time to get the mobile application data from D-tree because the data collectors needed to request a data report through D-tree staff.
- After the data were received from the D-tree database, their structure made it difficult to understand them. However, stakeholders also said that they were aware that D-tree was making some improvements to the system to make it more user friendly.

Results in Table 10 show that the availability of village clinic registers and monthly reporting forms was higher compared to the availability of iCCM mobile application entries in the D-tree database among the HSAs included in the study. Thus village clinic registers and monthly summary forms were more often available for one or both of the assessed months compared to the data reported by the same HSAs through the mobile application. When HSAs from both intervention and comparison districts were asked when they have usually recorded information in the village clinic register in the past month, as expected, almost all HSAs (99.6 percent) in the comparison group said that they used it during a consultation, and a surprisingly high percent of HSAs (about 56 percent) who are mobile users said that they had used the village clinic register during a consultation. This may explain why some of the data are not available in the D-tree database, because they were collected first using the paper forms.

Data from the paper sources were available for both months (June and July 2016) assessed in registers for 83.2 percent of HSAs and in monthly reporting forms for 84.2 percent of HSAs. About 15 percent of HSAs had data in both data sources for one of the two months. Notably, four HSAs were on leave for one of the months assessed (three HSAs in Ntcheu, one HSA in Mzimba North), and another HSA did not open his clinic for one of the months assessed due to illness. Availability of iCCM mobile application data was lower. Of the HSAs who used the mobile application, 72.2 percent had mobile application data available for both months assessed, and 15.2 percent of the HSAs had no mobile application data for either month assessed.

**Table 10: Data Availability by Data Source (N=159)**

Number of Months	Village Clinic Register		Form 1A		iCCM Mobile Application	
	Weighted %	(95% CI)	Weighted %	(95% CI)	Weighted %	(95% CI)
2	83.2	(67.9, 92.0)	84.2	(68.7, 92.9)	72.2	(57.7, 83.2)
1	15.8	(7.1, 31.3)	15.4	(6.9, 31.1)	12.6	(5.8, 25.2)
0	1.0	(0.3, 3.2)	0.3	(0.0, 2.5)	15.2	(7.2, 29.4)

Table 11 disaggregates these data by district. As with the overall availability results, the availability of village clinic register and monthly summary report data are consistent in each district, whereas mobile application data availability was lower in three of the four districts. In Ntcheu district, however, the availability of mobile data (95.8 percent) exceeded that of the village clinic register data (84.7 percent) and monthly summary form (84.7 percent) data. On the other hand, less than half of HSAs in Dedza

district had mobile application data available for review, but 75.7 percent had data available in their village clinic registers and monthly summary forms.

**Table 11: Data Availability by Data Source and District**

District	Number of Months	Village Clinic Register		Form 1A		iCCM Mobile Application	
		Weighted %	(95% CI)	Weighted %	(95% CI)	Weighted (%)	(95% CI)
Dedza (N=49)	2	75.7	(43.1, 92.8)	75.7	(43.1, 92.8)	49.8	(27.5, 72.2)
	1	24.3	(7.2, 56.9)	24.3	(7.2, 56.9)	17.5	(4.7, 48.0)
	0	0.0	-	0.0	-	32.6	(13.2, 60.6)
Mzimba North (N=37)	2	85.5	(49.2, 97.3)	88.0	(47.0, 98.4)	66.0	(36.1, 87.0)
	1	12.0	(1.6, 53.0)	12.0	(1.6, 53.0)	17.0	(4.0, 50.2)
	0	2.5	(0.6, 10.1)	0.0	-	17.0	(4.0, 50.2)
Ntcheu (N=44)	2	84.7	(55.6, 96.1)	84.7	(55.6, 96.1)	95.8	(88.7, 98.5)
	1	15.3	(3.9, 44.4)	15.3	(3.9, 44.4)	3.1	(0.9, 9.8)
	0	0.0	-	0.0	-	1.0	(0.1, 7.4)
Ntchisi (N=29)	2	93.1	(76.0, 98.3)	96.6	(78.8, 99.5)	75.9	(57.1, 88.1)
	1	3.4	(0.5, 21.2)	0.0	-	17.2	(7.3, 35.6)
	0	3.4	(0.0, 21.2)	3.4	(0.5, 21.2)	6.9	(1.7, 24.0)

## Completeness

The data collectors reviewed each entry in the village clinic register for completeness. To do so, each entry was divided into five information sections—client, assessment, classification, treatment and referral, and follow-up—and assessed individually. Assessments for each individual section were also aggregated to provide an overall assessment of the entries. On average, HSAs completed three of the five information sections—client, classification, and treatment and referral—more than 90 percent of the time, but only completed the assessment section 83.7 percent of the time (see Table 12). Follow-up was completed across approximately a third of the entries, which consequently lowered the overall completeness rate to 28.6 percent.

**Table 12. Completeness by Data Source**

Section	Weighted Mean (%)	(95% CI)
<b>Village Clinic Register</b>		
Overall	28.6	(18.9, 38.2)
Client information	96.7	(94.9, 98.4)
Assessment	83.7	(76.6, 90.7)
Classification	91.9	(85.1, 98.5)
Treatment and referral	94.2	(91.4, 96.9)
Follow-up	33.1	(22.4, 43.8)
<b>Form 1A</b>		
Overall	61.0	(49.8, 72.1)
HSA information	87.6	(79.4, 95.8)
New illness cases	90.4	(84.3, 96.4)
Referrals	88.1	(81.9, 94.4)
Deaths	87.0	(80.4, 93.5)
Totals	87.4	(81.2, 93.6)
Supplies	91.1	(85.0, 97.1)
Supervision	84.3	(76.0, 92.6)
Signed	72.1	(61.5, 82.7)
<b>iCCM Mobile Application</b>		
Not available (See explanation in text)		

Data collectors divided the entries on the monthly summary forms into seven sections—HSA information, new cases of illness, referrals, deaths, totals, supplies, supervision, and signature—and

assessed each section individually for completeness. An overall assessment of the forms was calculated. HSAs had high completion rates for individual sections of the monthly summary forms. Completion rates for six of the eight sections—HSA information, new cases of illness, referrals, deaths, totals, and supplies—averaged more than 87 percent. HSAs completed the supervision information in 84.3 percent of the forms and signed 72.1 percent of all forms. HSAs had a 61 percent overall completion rate on all sections of the forms.

The content and structure of the village clinic register entries and the monthly summary forms precluded direct comparison in the analysis. The treatment and referral sections of the village clinic register, however, align with the new illness cases and referral sections of the monthly summary forms. In both data sources, these sections were completed on approximately 90 percent of the entries.

Through conversations with D-tree about the completeness of the mobile application records, ICF understood that incomplete records should be an anomaly. Data are only saved when an HSA reaches a “stop point” in the mobile application protocol, so if an HSA exits out of the mobile application before reaching a stop point, none of the data entered before the stop point are saved.

There are two stop points in the mobile application protocol: (1) when an HSA should administer an mRDT, and (2) when the HSA reaches the end of the protocol. If a child presents with fever and the HSA has mRDTs in stock, there is a stop point during which the HSA should administer an mRDT. After the HSA administers the mRDT, he or she must go back into that child’s sick child visit record in the mobile application and continue with the protocol until reaching the end. If a child does not present with fever or if the child does but the HSA does not have any mRDTs in stock, then the only stop point is when the HSA reaches the end of the protocol.

Based on these conversations, the only instance in which incomplete information is a possibility is if an HSA is prompted by the mobile application to administer an RDT and then does not enter back into the mobile application to complete the sick child assessment. ICF found that sick child visits that did not include mRDT administration had only one record, but sick child visits that included mRDT administration could have between one and four records. Two records was most common, but one record was uncommon. Furthermore, when comparing the individual records for sick child visits with multiple records, much of the assessment information was the same, but differences did sometimes exist. ICF did not quantify these differences and has yet to learn from D-tree why they exist. ICF found that the D-tree data dictionary, or codebook, provided to help ICF understand the database was incomplete, which made it challenging for ICF staff to understand without assistance from D-tree staff. The dictionary only contained example values for a subset of the database fields. Information about the fields’ formats and definitions, a listing of all possible values, and relationships between the fields was not included.

ICF was, therefore, unable to fully assess the completeness of D-tree’s database records following the same procedures used for the other two data sources. Instead, ICF examined the number of records in the database compared to the number of sick child visits in the database to better understand the contents of the database because there were more records than sick child visits. We found 14,381 total records in the two month dataset for the HSAs included in the study. Of these, there were seven duplicate records. The 14,374 unique records contained information for 9,027 sick child visits. For these sick child visits, 3,687 had one database record; 5,340 had two records; 6 had three records; and one had four records. Except for six sick child visits with two records, all records for sick child visits that did

not call for the HSA to administer an mRDT (2,375) had one record. The other 6,652 sick child visits involved administration of an mRDT. Almost all sick child visits with two records in the database (5,334) were for children who presented with fever and were administered an mRDT, but not all sick child visits during which an HSA administered an mRDT had two records; 1,318 of these sick child visits only had one record.

## Consistency

For the two months assessed, the HSA village clinic registers had 13,238 sick child entries, and the HSA monthly summary forms had entries for 14,219 new cases (7,167 female and 7,052 male). The iCCM mobile application database for the same time period and the same HSAs had entries for 9,027 sick children.

Table 13 shows the average counts reported by HSAs for children assessed, mRDT positive malaria cases, diarrhea cases, fast breathing cases, and referrals with danger signs across village clinic registers, Form 1A, and the mobile application data. The counts in the monthly summary forms are, on average, slightly higher than the verified counts in the village clinic registers. The counts in the mobile application are much lower, as would be expected from the availability results reported earlier. Similar trends exist across the three data sources: the number of mRDT positive malaria cases is greater than the number of fast breathing cases, which is greater than the number of diarrhea cases. The number of referrals with danger signs is small in all three data sources.

We analyzed the differences among the three data sources further by calculating verification ratios between the village clinic registers and the monthly summary forms, and between the village clinic registers and the mobile application. In these calculations, a verification ratio equal to one indicates perfect agreement between the village clinic register and the monthly summary form or mobile application. A verification ratio greater than one indicates that the counts in the village clinic registers were greater than the counts in the monthly summary forms, and a verification ratio less than one indicates the opposite.

**Table 13: HSA Mean Counts by Data Source (N=159)**

Indicator	Village Clinic Register			Form 1A			iCCM Mobile Application		
	Weighted Mean	(95% CI)	Range (Min, Max)	Weighted Mean	(95% CI)	Range (Min, Max)	Weighted Mean	(95% CI)	Range (Min, Max)
Children assessed	86.5	(65.1, 108.0)	(0, 444)	91.7	(71.0, 112.4)	(0, 464)	58.1	(40.2, 76.1)	(0, 433)
mRDT Positive malaria cases	51.6	(33.7, 69.5)	(0, 340)	60.6	(40.0, 81.1)	(0, 440)	30.7	(17.9, 43.5)	(0, 322)
Fast breathing cases	28.5	(24.1, 32.9)	(0, 101)	32.1	(27.0, 37.3)	(0, 130)	17.5	(13.0, 22.0)	(0, 86)
Diarrhea cases	11.8	(9.3, 14.3)	(0, 64)	16.7	(12.1, 21.3)	(0, 120)	8.6	(5.7, 11.5)	(0, 62)
Referrals with danger signs	1.3	(0.7, 2.0)	(0, 33)	2	(1.1, 2.9)	(0, 33)	1.5	(1.0, 2.1)	(0, 34)

The verification ratios comparing the village clinic registers to the monthly summary forms showed, on average, good agreement for children assessed, mRDT positive malaria cases, and fast breathing cases (see Table 14). The verification ratios decreased for diarrhea and referral cases, indicating higher counts for the monthly summary form than for the village clinic register.

The verification ratios comparing the village clinic registers to the mobile application showed higher counts for the village clinic registers for all indicators, except referrals with danger signs.

**Table 14: Verification Ratios**

Indicator	Village Clinic Register: Form 1A			Village Clinic Register: iCCM Mobile Application		
	N	Weighted Mean	(95% CI)	N	Weighted Mean	(95% CI)
Children assessed	152	1.01	(0.92, 1.09)	138	2.88	(1.80, 3.96)
mRDT positive malaria cases	152	0.98	(0.90, 1.07)	136	3.29	(2.05, 4.53)
Fast breathing cases	153	0.99	(0.89, 1.08)	131	2.32	(1.74, 2.90)
Diarrhea cases	153	0.82	(0.73, 0.91)	130	1.78	(1.37, 2.18)
Referrals with danger signs	139	0.83	(0.68, 0.99)	139	0.79	(0.65, 0.93)

Note: The number of HSAs included in the verification ratios varied among the indicators because if the count in the denominator (the monthly summary form or mobile application) was zero, a ratio could not be calculated. If counts were zero in both sources being assessed, the ratio was set to be 1, to indicate agreement between the two sources. Consequently, HSAs were omitted if the count in the denominator (i.e., mobile application or monthly summary form) was zero but the count in the village clinic register was non-zero.

The differences among the three data sources were also analyzed by calculating count differences between the village clinic registers and the monthly summary forms, and between the village clinic registers and the mobile application. In these calculations, a positive mean indicates that the counts in the registers were greater than the counts in the monthly summary forms or mobile application, and a negative mean indicates the opposite. As noted earlier and as seen in Table 15, the counts in the village clinic registers were, on average, less than those reported in the monthly summary forms but much greater than those in the mobile application. The village clinic register counts, compared to the monthly summary form results, indicate mean differences between 3 and 9 cases, while the village clinic register counts, compared to the mobile application results, show mean deviations of almost 30 cases for children assessed and almost 22 mRDT positive malaria cases. The mean case difference for children assessed for fast breathing was 11.4 cases, and there were 3.4 more diarrhea cases in the village clinic register than in the mobile application. The differences for referrals with dangers signs are similar when comparing the village clinic registers to both of the other data sources.

**Table 15: HSA Mean Count Differences (N=155)**

Indicator	Village Clinic Register: Form 1A		Village Clinic Register: iCCM Mobile Application	
	Mean	(95% CI)	Mean	(95% CI)
Children assessed	-3.7	(-13.8, 6.4)	29.7	(14.3, 45.0)
mRDT positive malaria cases	-8.4	(-18.1, 1.3)	21.6	(8.5, 34.7)
Fast breathing cases	-3.1	(-5.7, -0.4)	11.4	(7.9, 15.0)
Diarrhea cases	-4.9	(-7.9, -1.8)	3.4	(0.7, 6.1)
Referrals with danger signs	-0.6	(-1.4, 0.2)	-0.05	(-0.7, 0.6)

## What are the factors that facilitate or hinder implementation of the D-tree mobile application that will affect its adoption and scale-up for iCCM programs in other districts in Malawi?

### Background of Key Informants

Key informant interviews were conducted with 47 major stakeholders to collect qualitative data on people's perceptions and to increase understanding of the context in which the iCCM mobile application was implemented. The interviews also provided clues to the factors affecting mobile application

adoption and scale-up. The results are organized by levels of the iCCM program system: national, district, SHSAs (facility), and then caregivers. At the district and facility levels, interviews were conducted with key informants in intervention and comparison districts, with two key informants per district. Researchers also interviewed five stakeholders at the national level. Open-ended questions were also included in the HSA questionnaire to understand their perspectives on the quality of care, data quality, and data use for decision making. Table 1 in the Evaluation Methods Section summarizes the interview subjects.

The national-level informants had served in their current positions for at least 2 to 4 years, except the manager of the IMCI unit, who had the longest tenure with 13 years. The district coordinators interviewed for the study had a range of experience, but with no substantial difference between coordinators in the intervention or comparison districts. Their tenure ranged from less than 1 year to 8 years for both groups. This is similar to experience levels among SHSAs in both groups, although, many of them had served for longer than 10 years in their current positions. In addition, the caregivers interviewed in this study were between 20 and 40 years of age.

National informants described their major job responsibilities as:

- Managing and coordinating programs, and planning and monitoring implementation of IMCI and iCCM activities.
- Ensuring data quality reporting and developing data collection tools for the program.
- Overseeing data collection and coordinating resources and training among stakeholders involved in iCCM activities.
- Overseeing the implementation of the mobile application, including the administrative relationships between stakeholders and the technology.
- Ensuring that the mobile application is functioning correctly.

Several district coordinators characterized their role as a link between partners involved in the iCCM project, which included the following activities: planning, implementing, and monitoring; coordinating training activities; ensuring that health facilities have supplies; and preparing for visits by IMCI stakeholders. They also said that they are involved in conducting training for HSAs, coordinating meetings with facility and district staff, and monitoring supplies at village health clinics. Monitoring activities included collecting data from health facilities, analyzing reports, and supervising implementation of iCCM activities. District coordinators in the intervention districts were asked whether they received supervisory training for the iCCM mobile application. Four out of eight respondents said that they had received training within the past two years. The SHSAs understood their responsibilities as supervising the HSAs assigned to them and aggregating and collecting data.

## Factors Facilitating the Adoption of the Mobile Application

When key informants were asked to identify the factors that they think facilitate the adoption of the mobile application, they provided numerous factors that are discussed in this sub-section.

**Initial collaborative effort and support.** Key informants described an initial collaborative process to introduce the mobile application. D-tree led the development of the mobile application, with support and input from MOH and Save the Children. After development of the mobile application, MOH, Save the Children, and D-tree developed a joint training calendar and convened trainings in districts participating in the pilot. Key informants also described a similar process across districts for introducing



the mobile application in their districts. The first step involved a briefing and orientation for the district health management team, followed by training for the HSAs about the use of the mobile application. The HSAs, in turn, were responsible for raising awareness among community members about the mobile application and how it would be used. Several respondents described collaborating with village health committees to inform the general public about the program.

**Recruiting young HSAs.** Multiple informants at all three levels suggested that younger HSAs have an easier time adopting the mobile application. They attributed this to the fact that young HSAs tend to be more familiar and comfortable with technology in general. Some informants also observed that young HSAs usually have better eyesight, which makes it easier to operate the phone.

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*Young people master it very easily, while older ones find difficulties.*  
District Key Informant, Ntchisi

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Most key informants at the district and facility levels reported that HSAs in their jurisdictions like the mobile application overall and generally find it easy to use. Most informants said that it takes one month or less to master the mobile application, which matches the estimate provided by D-tree staff. Stakeholders at the MOH level, however, said that it takes users less than a week to master the mobile application, while some informants at the facility level described a longer timeframe. Key informants also said that most HSAs like the mobile application because it simplifies their work, especially for assessing and categorizing patients, selecting treatment options, and communicating with health facilities.

**Phone ownership.** Most key informants in the intervention districts had a positive perspective of HSAs owning a phone. The informants said that the mobile application has had a positive impact on the iCCM program in their district. They cited improvements in diagnostic accuracy, treatment and drug monitoring, and reporting. Other informants said that the mobile application has improved morale among HSAs. Some district coordinators also noted that the use of the mobile application has resulted in no overall difference in the iCCM program because the phone is just an electronic version of the register.

**Opportunities to practice.** Several informants observed that HSAs become proficient with the mobile application by practicing it. For example, one district staff member in Ntcheu noted that, “The more they use, it the more they get used to its use.”

**Training and supervision.** Key informants frequently cited training and supervision as a factor facilitating adoption of the mobile application. For example, a district staff in Ntcheu observed that, “During supervisory visits, we check [HSAs’] phones [to see] if they are functional.” Several informants credited the use of supervisory checklists with ensuring that HSAs are using the phones as instructed. Some district coordinators also said that they monitor the mHealth application dashboard to identify HSAs who are struggling to use the application and then take corrective action as needed.

**Super-users.** Several key informants credited the establishment of “super-users” for facilitating adoption of the mobile application. According to D-tree staff, super-users are HSAs who receive extra training on how to troubleshoot basic issues with the mobile application. Each facility has one super-user. Super-users frequently reinstall the mobile application and help HSAs learn how to become more comfortable with the technology. If a hardware problem or other issue arises that a local super-user cannot resolve, key informants said that they contact the D-tree office and the district IMCI coordinator for guidance.

## Barriers to Using the Mobile Application

When asked about problems HSAs encounter when using the mobile application, key informants at the district, facility, and national levels described similar issues. For comparison, key informants in the comparison districts were also asked to identify common problems with the paper forms. The most common problem they described is the failure of HSAs to complete all parts of the forms, especially page summaries. Key informants also noted that some HSAs do not transfer information to the register accurately or completely from the mobile application. Because these problems stemmed from user error, key informants said that they are addressed through individual supervision and refresher training.

Key informants reported the following barriers to implementing the mobile application:

**Lack of national policy.** Key informants felt that although the rationale for adopting and scaling up the mobile application is to address adherence to the iCCM protocol by HSAs, which was an issue, they observed a lack of national policy in place to support the implementation of the mobile application in Malawi. Meanwhile, the national mHealth Technical Working Group is providing guidance to the implementation of the mobile application.

**Limited access to the D-tree database.** Most key informants in intervention districts and at other levels said that they do not have access to data submitted to D-tree from the mobile application. They said that instead, they rely on data from village clinic registers, Form 1A, and DHIS 2 for reporting and decision making. They also felt confident that some errors made by using paper forms are easily identified and corrected during monthly review meetings using the supervisory checklist.

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*It is easy for SHSA to catch HSA [errors] by looking at the consistence of a case and by following supervisory checklist [paper].*

SHSA, Rumphi

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**Limited network coverage.** Other key informants said that the network coverage is limited in some areas where HSAs live and work, which limits their ability to sync their data as regularly as expected.

### **Limited MOH capacity and resources in technology.**

Key informants felt that the responsibility and control of the mobile application is concentrated at D-tree. Although D-tree has collaborated well with the MOH, most key informants felt that the MOH has limited human capacity and other resources necessary to implement the technology. For example, an informant in the MOH reported not having the capacity to implement the mobile application without the support from D-tree and other donor agencies.

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*If D-tree were to close shop today, MOH does not have the competence, resources, and understanding to run the show.*

National Key Informant

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**Software problems.** Several key informants said that software problems are common and often cause the mobile application to freeze or malfunction, such as a failure to sync data.

**Hardware problems.** Informants said that, based on where the HSAs operate, such as rural areas, their phones have frequent issues that cause them to break down. Some informants described a problem with dust penetrating the phone casing, resulting in frequent problems.



**Inadequate battery power.** Informants reported issues with inadequate battery power for phones or problems charging the phone, especially if the weather is not conducive to solar charging, such as during the rainy season.

**Insufficient airtime for data availability.** Although HSAs receive airtime every month, they reported issues with the timeliness and sufficiency of the airtime, which causes delays and leads to HSAs using their own data plan or just not using the phone.

**Operator error.** Informants reported operator errors, such as accidentally deleting the application or pressing the wrong keys.

**Inadequate troubleshooting training.** Some district coordinators observed that some SHSAs have not been adequately trained on how to troubleshoot problems with the application and how to provide assistance to HSAs under their supervision. A district informant in Mzimba North said that they had created a WhatsApp social group with HSAs in the district to share and discuss their problems with peers and district-level staff, which has helped resolve some of the issues.

## Use of iCCM Data for Program Decision Making

Both groups of HSAs were asked what they do with the data they collect through either the paper form or the mobile application, and the majority of them reported using the data for reporting purposes, including recording them in village clinic register, tallying them monthly in Form 1A, or submitting them to D-tree using the mobile application (see Table 16). In addition, about 35 percent of HSAs said that they use the data they collect to display in their village clinics, talk about them with community members, and use the data to make decisions in their work. However, there were no significant differences between the HSAs who use the mobile application and the HSAs who use the paper form in their use of data to improve their work. HSAs regardless of data collection tool used also provided comparable examples of the decisions they make using the iCCM data they collect, including community sensitization and health talks on the situations of increased diarrhea or malaria cases in the community and how to prevent them.

**Table 16: How HSAs Use the Data they Collect by Data Source (N=292)**

	Comparison (N = 132)		Intervention (N = 160)	
	%	(95% CI)	%	(95% CI)
Record data in village clinic register	63.4	(48.6, 76.1)	48.5	(35.6, 61.7)
Tally data monthly in Form 1A	55.8	(40.8, 69.8)	46.4	(33.6, 59.7)
Submit data via phone	0.4	(0.0, 2.6)	41.0	(28.5, 54.7)
Display data in my village clinic	28.6	(17.4, 43.3)	36.3	(24.2, 50.3)
Talk about data with community members	16.6	(8.7, 29.4)	24.8	(14.5, 39.2)
Make decisions	33.6	(21.8, 47.9)	38.1	(26.5, 51.3)
Other	24.6	(13.9, 39.7)	16.1	(8.1, 29.6)

Notes: HSAs could select multiple options, so these numbers do not sum to 100 percent.

Several informants from the national, district, and facility levels in the intervention districts also said that the data submitted to D-tree were not easily accessible or usable and that the data were not comprehensive. As a result, there are currently many more records in the registers, which are being reported accurately in Form 1A, compared to records in the D-tree database. Numbers reported using the mobile application are too low to be able to rely on the D-tree data for program decisions.

## DISCUSSION

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### Quality of Care

HSAs who used the iCCM mobile application had higher rates of assessing and classifying sick children, compared to HSAs using paper tools. No statistically significant differences were found between these two groups in treating sick children or counseling caregivers, most likely because the sample was much smaller than the number of children assessed and classified. The predicted probabilities of correct treatment and counseling between the two groups, however, were largely similar, which corroborates similarity in treatment and counseling patterns between the two groups. Overall, the quality of care delivered by HSAs, regardless of the tool used to guide the sick visit, trended toward the upper end of previous studies conducted on adherence to the iCCM or IMCI protocol in Malawi and other countries.<sup>37</sup>

HSAs using the mobile application had higher rates of assessment for all items in the iCCM protocol, compared to HSAs using the paper tools, with the exception of assessing for the presence of fast breathing and malaria. The mobile application forces HSAs to count breaths for one minute and to assess for malaria using an mRDT by incorporating breaks in the application followed by prompts requesting the results of these assessments. The village clinic register also contains sections in which HSAs can include the number of counted breaths and the results of the mRDT, but these sections can be more easily overlooked. Similarity in the rates of assessments for fast breathing and malaria indicates that HSAs, regardless of the tool used to guide the sick child visit, adhere to the iCCM protocol in counting breaths and administering mRDTs. This may be partially driven by recent refresher trainings delivered by the MOH in respiratory counting and administering mRDTs.

Less than 3 percent of HSAs in both groups would have prescribed antibiotics to children not classified with cough and fast breathing and therefore not needing an antibiotic according to national iCCM guidelines. This is a dramatic decrease from the results indicated by a previous quality of care study, which found that 31 percent of children not needing antibiotics were treated with antibiotics.<sup>38</sup> The study indicated that the inappropriate treatment mainly stemmed from errors in the counting of respiratory rates. The MOH has made deliberate efforts to improve respiratory counting by offering refresher trainings to HSAs. This has resulted, at least in this population, in improvements in respiratory counting by HSAs and rational antibiotic prescription practices.

More than 90 percent of HSAs using either the mobile application or paper tools correctly classified malaria (identified by a positive mRDT) among sick children. Despite similarities in classification rates, treatment rates of malaria diverged between the two groups of HSAs: HSAs using the mobile application (80 percent) tended to correctly prescribe an antimalarial drug to children diagnosed with malaria more frequently than HSAs using paper tools (52.8 percent). A previous quality of care study conducted among HSAs in Malawi found a similar decrease between the percentages of children correctly classified with malaria (92 percent) and correctly treated (79 percent).<sup>39</sup> In that previous study, stockouts of the antimalarial drug during the time of the sick child visit accounted for incorrect treatment. For this

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<sup>37</sup> Gilroy KE, Callaghan-Koru JA, et al. 2012. Quality of sick child care delivered by health surveillance assistants in Malawi. *Health Policy and Planning* 28:573-585.

<sup>38</sup> Ibid.

<sup>39</sup> Ibid.

evaluation, however, HSAs prescribed treatment as if no stockouts existed, and still HSAs in comparison districts largely failed to prescribe any treatment to children diagnosed with malaria. Further analysis investigating the reasons for lack of treatment, especially in the comparison districts, is suggested.

A large percentage of children in both the intervention and comparison groups did not receive the correct first dose of treatment at the village clinic; although statistically insignificant, HSAs using the mobile application provided this correct first dose less frequently than those using paper tools. The iCCM protocol advises HSAs to give the first dose of treatment to the sick child at the village clinic to help the caregiver understand the treatment procedures. A previous study conducted in three of the seven districts—Lilongwe, Mzimba North, and Ntcheu—indicated that few HSAs had cups, spoons, and materials available for mixing the medication.<sup>40</sup> We did not assess whether these items were included in the HSA drug boxes. In addition to administering the first treatment dose, HSAs also counsel caregivers on how to administer treatment. Results corroborated that HSAs gave limited counseling on the dose, frequency, and duration of treatment and demonstrated the treatment, and then asked the caregivers to repeat the instructions for the treatment procedure. Again, HSAs using mobile application counseled caregivers at a lower rate across the three common illnesses, compared to HSAs using the paper tools. Of the three illnesses, only diarrhoea showed a statistically significant difference between the two groups, with only 5 percent of HSAs using the mobile application counseling caregivers on diarrhea treatment, compared to 23 percent of HSAs using paper tools. Results from the caregiver interviews that assessed the caregivers' understanding of treatment indicated that all but one caregiver was able to correctly describe how to give the correct treatment. The small sample of interviewed caregivers, however, makes it difficult to determine how widespread this understanding is. These results suggest that use of the mobile application does not positively influence counseling behavior of the HSA, but the reasons behind limited counseling across the two groups is not well understood with the available data. Qualitative analysis investigating why HSAs tended not to counsel caregivers is warranted, especially among HSAs using the mobile application.

## Data Quality Assessment

Overall, we observed good availability, completeness, and consistency of data collected by HSAs through paper forms, compared to data collected through the iCCM mobile application. Similar availability trends were observed across the four intervention districts, except in Ntcheu district, where 95.8 percent of HSAs had iCCM mobile application data available, compared to 84.7 percent of HSAs with data in both their village clinic registers and monthly summary forms. Although the availability trends were similar in Mzimba North and Ntchisi districts, percentages in Dedza district were notably lower for all three data sources. Dedza district had the lowest percentage of HSAs with available iCCM mobile application data (49.8 percent) and paper forms (75.7 percent). It is unclear why only about half of the HSAs in Dedza district reported data through the mobile application, compared to 96 percent of HSAs in Ntcheu district. Further investigation is needed to better understand this discrepancy. In general, lack of mobile data availability could be explained by the reported frequent issues related to the iCCM mobile application, such as hardware malfunctioning, failure to sync, or shortage of power to charge the phones, and other challenges that limit the HSAs' regular use of their phones. Perhaps Dedza district may have had more of these issues than the other districts. During the fieldwork, we noted that some HSAs

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<sup>40</sup> Ibid.

chose not to use their phones during the sick child visit, even when the phones were in working condition. Instead the HSAs used the village clinic register and then copied that information into the mobile application. More investigation is required to understand why some HSAs with phones in working condition preferred using paper form protocol to assess, classify, and treat sick children.

In addition, we found that the number of cases in the village clinic register and Form 1A were similar for the majority of HSAs, which suggests that many of the cases collected in the registers are making it into the HSAs' monthly summary forms and thus are likely available for HSAs and facility staff to use to assess HSA performance, identify outbreaks of illness—especially diarrhea—and address them. However, there was a large discrepancy between the number of records in the paper forms and the number of records in the D-tree database, indicating that only some data were captured and available in the D-tree database.

Although the data collected using the iCCM mobile application were captured instantly and stored in a secure database, in practice, these data were not readily accessible and retrievable by people who might want to use them. The D-tree data were mainly accessible to D-tree staff who retrieve and analyze the data and compile reports for users, including the MOH and other partners. This limitation has negative effects on the use of iCCM data for program decision making. These results were echoed during the key informant interviews of national- and district-level decision makers. D-tree was working on improving their dashboard, which was unavailable at the time of this evaluation. A functional, easy-to-use dashboard that allows HSAs, their supervisors, and other stakeholders to review and use the data in real time is an important component of the mobile application package that could make investing in the mobile application worthwhile. Furthermore, access to and understanding of the larger database of mobile application data is an important component of the mobile application package. Stakeholders may be interested in periodic, more in-depth analyses that go beyond the indicators available through the dashboard. To be able to do this, they need clear documentation of the structure and contents of the database, including the field definitions, allowable values, and relationships to the other database fields. The methods by which records are generated and updated must also be clear to users.

Although previous studies have argued that the use of mobile technology improves data availability for timely decision making, this evaluation suggests that this is the case only when the mobile phone works at all times and is used consistently, and the data are accessible to stakeholders.

Data completeness was high on the paper forms, with more than 84 percent of HSAs having entered all the required information on key indicators, including client information, assessment, classification, and treatment and referral. A smaller percentage of HSAs (33.1 percent), however, had complete information on follow-up in their village clinic registers, and 72.1 percent of the HSAs had their monthly summary forms signed. One possible reason the information on follow-up and signature are incomplete is because the HSAs view this information as low priority, compared to treatment-related data, which are closely monitored and required to account for the drugs that have been used. Despite the commonly held view that data collected by HSAs through the village clinic registers are not correctly aggregated and reported in the monthly summary forms, this evaluation showed that this was not the case in Malawi. Although a few HSAs showed large variations in what they recorded in their registers compared to what they reported in their summary forms, we found that the reports overall were complete, which could be explained by the effective training and supervision provided to HSAs on how to use the paper forms to collect, aggregate, and report iCCM data. This completeness of forms finding

was consistent with the key informant perceptions that the data collected through paper forms were of good quality mainly because it was easy for supervisors and even the HSAs themselves to identify and correct any errors made on a monthly basis during monthly review meetings before data are sent into the national database.

In comparison, data collected using the mobile application are submitted directly to D-tree and cannot be easily accessed for review. Also, because the mobile application typically has internal data quality control checks, we assume that all data collected using the mobile phone during the sick child visit should be correct and complete. The inability of the HSAs and their supervisors to access, compile, and reflect on the mobile data that they produce monthly is a missed opportunity for using data at the village clinic and facility levels. This points to the need for the dashboard to automatically generate summaries of individual records and monthly aggregates to facilitate reflections and use of the data to improve HSAs' work.

Data consistency showed some differences among the three data sources—the village clinic registers, the monthly summary forms, and the iCCM mobile application. Our comparison of the village clinic registers to the monthly summary forms showed good agreement in the number of mRDT positive malaria cases and fast breathing cases, but less agreement in the number of diarrhea and referral cases, which were higher in monthly summary forms than in the village clinic registers. In a comparison of village clinic registers to the iCCM mobile application, we found that the village clinic registers had more entries for all indicators except referrals with danger signs than the iCCM mobile application. Some of these results could be explained by the limited availability of data for the iCCM mobile application; data were not being submitted to the D-tree database perhaps because the HSAs did not always use their phones. The finding that referrals with danger signs occurred more frequently with the mobile application was not surprising because when a referral is made through the iCCM mobile application, the HSA must follow the protocol in the phone while he or she is managing the case and thus when the HSA completes the sick child visit using the mobile phone application, the data are saved. When HSAs use the village clinic register, they sometimes give a referral on a referral sheet without recording it correctly in the register. It is also not a priority indicator for HSAs; we speculate that HSAs are more concerned with treatment indicators so they can track their stocks of medicines and have them replenished when they are running out.

## Facilitators and Barriers to the Use of the Mobile Application

Several key informants throughout the iCCM implementation system felt that the use of the mobile application as a supportive tool to improve the quality of care and data quality was viewed positively. Several informants, including caregivers, said that they trusted the HSAs who were using the mobile application for their sick children. Overall, the informants thought that a number of factors had helped improve the implementation of the iCCM mobile application and that there were also several challenges that hinder its adoption and scale-up. Several informants indicated that factors facilitating the use of the iCCM mobile application included collaboration among key stakeholders such as MOH, implementing partners, the technology development partner, and communities; regular training and supervision of HSAs; creation of super-users; opportunities for HSAs to practice with the phone under supervision of a mentor; phone ownership by HSAs; and the involvement of young HSAs.

Many of the informants also highlighted a number of barriers to the use of the mobile application, including the lack of a national mobile technology policy and limited human and resource capacity at the MOH to support its implementation, limited access to the D-tree database, and hardware problems with the phones. During fieldwork for this study we found that a large number of HSAs did not use their mobile phones for sick child visits. During data collection, barely half of all HSAs initially sampled to participate in the study indicated that they used the mobile application for sick child visits. Anecdotal evidence suggests that this was often due to hardware issues or problems with charging the phone battery. Furthermore, casual observation indicated some HSAs relied first on the village clinic register during the sick child visit and then copied this information into the mobile application. A more detailed study is warranted that would further explore the HSAs' perceptions of the usefulness of the mobile application to guide sick child treatment and the practical barriers to implementing the mobile application.

## Study Limitations

The evaluation plan was not part of the program design. As a result we are not able to randomize the intervention nor have a baseline assessment. In selecting a comparison group, HSAs, and children, we were limited to the areas where the project was already operating and has conducted iCCM trainings for HSAs, and to the HSAs that were already active in these areas. Because of a lack of baseline assessment, we were unable to determine if any differences existed between the intervention and comparison groups prior to the implementation of the mobile application regarding, for example, district capacity and characteristics. We used multivariate regression analysis to control for possible confounding factors related to the district, facility, and HSA observable characteristics that may bias our findings. Relying on observation of HSAs as they assess sick children has the potential to introduce bias if HSAs change their assessment habits to satisfy the observer. This type of bias tends to overestimate the quality of care provided and lead to smaller than expected differences in performance between HSAs in the intervention and comparison groups. The data quality component of the evaluation focuses only on HSAs using both the mobile application and paper forms. Using the same HSAs may have introduced biases because many HSAs copy the data from the phone to the paper, and the other way around.

## Recommendations

Based on the findings related to whether HSAs using the mobile application improve the **quality of care** for children under five years of age, compared to the quality of care received from HSAs using paper tools, we recommend conducting a cost-benefit analysis to quantify whether the added benefits of improved assessment, classification, and treatment rates of the mobile application outweigh the additional costs of scaling up the mobile application. This analysis should compare other strategies that could lead to similar improvements, such as additional training or mentoring visits, to using the mobile application.

Based on the findings related to whether using a mobile application versus paper forms to collect and report improves **data quality and data use for decision making** in the iCCM program, we offer the following recommendations:

- **Improve the availability and accessibility of the D-tree mobile application data.** The present process through which users gain access to the data collected from the mobile application

and submitted to the D-tree database poses barriers to data use for decision making. D-tree should make a concerted effort to make their data readily available and accessible by users. One mechanism is to allow potential users to download data from D-tree's website through public use data files, which could be analyzed to generate reports for use in programming decisions. Another mechanism, although not mutually exclusive, is to create a process such that the D-tree database can be fully integrated into the MOH DHIS 2 system.

- **Build the capacity of MOH in terms of human resources and infrastructure so that D-tree can shift responsibility and control of the mobile application to MOH,** which enhances the scale-up and sustainability of the mobile application. D-tree and donor agencies need to intentionally build and strengthen the capacity and infrastructure of the MOH and other implementing partners to implement the mobile application for the iCCM program, especially at the national level, before scaling it up.
- **Develop and implement a national mobile technology policy and strategies to support the implementation of iCCM programs in mHealth.** A clearly articulated mobile technology policy will help facilitate the government to allocate resources for its adoption. Strategies for implementation need to be coupled with a budgeted implementation plan, earmarked funding, and clear standard operating procedures for managing data quality and use at the HSA, supervisor, IMCI focal person, and manager levels. Part of this strategy should be the recruitment of more young people to be HSAs and the training of more super-users to help with timely trouble shooting.
- **Continue to train HSAs and improve the quality of data generated through the use of paper forms as the main source of data for supporting decision making for the iCCM program.** Until HSAs are able to use the mobile application consistently to capture data for all cases that they see, MOH and other decision makers should emphasize and continue to use paper-based data as a reliable source of good quality data that are available, complete, and consistent.
- **Commission further research on the potential benefits of a mobile application to facilitate the use of data for program decisions.** The research should investigate the barriers to the uptake of the application and to capturing acceptable levels of data before expanding the mobile application to more districts.



## CONCLUSION

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Results of the study lend some support to the use of the mobile application as a tool to facilitate shifting tasks to less-trained health surveillance workers, especially considering the severe shortages of trained health personnel in hard-to-reach areas of Malawi. HSAs using the mobile application correctly assessed and classified sick children at a higher rate than HSAs using paper tools, although no differences were found in treatment rates. The lack of effect on treatment rates points to additional support required regarding adherence to the treatment protocol before any full-scale implementation of the mobile application.

Results of the assessment of the quality of data reported by HSAs through paper forms, compared to the mobile application, show significant differences between the two systems. Overall, the results favor the use of village clinic registers and monthly summary forms to collect and report good quality data, compared to the mobile application. More data were available and consistent when HSAs used the paper forms, compared to the mobile application, which was partly explained by infrequent use of the mobile phones due to several challenges, including hardware issues. The results do not imply that mobile applications collect poor data, but instead indicate a need for policy makers and program staff to think about the broader contextual factors, such as network coverage, wear and tear of hardware and software, airtime, HSA age, and other factors that limit the continuous use of the mobile application when planning for scale-up of the mobile application.

Several key stakeholders from both intervention and comparison districts said that they were in favor of expanding the use of the mobile application across the country; however, they also noted that although the mobile application has potential, they are unsure if resources needed are available to expand and sustain its implementation in the iCCM program nationwide. In addition, the caregivers did not identify the HSAs' use of a mobile application among the list of improvements they will like to see to improve quality of care. Instead, the caregivers said that they will like to see improvements such as construction of a village clinic and toilets, drug availability, and opening the clinic every day.



## APPENDIX 1 AND 2: HSA QUALITY OF CARE TOOL

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### ICF RAcE Malawi mHealth Evaluation 2016 HSA Quality of Care Assessment Tool

#### Tool A: HSA Observation Checklist

#### HSA AND CHILD BACKGROUND INFORMATION

**District:** [Select one from list]

**Facility:** [Select one from list]

**HSA:** [Select one from list]

**Child Number:** \_\_\_\_\_

**Child sex:** (1) Male

(2) Female

**Child age (months):** \_\_\_\_\_

**Caregiver sex:** (1) Male

(2) Female

**Caregiver relationship:** (1) Mother

(2) Father

(3) Other, specify: \_\_\_\_\_

**iCCM protocol tool used by HSA:** (A) Sick child recording form

**(Select all that apply.)**

(B) Village clinic register

(C) Mobile application

(D) Other, specify: \_\_\_\_\_

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#### A. HSA ASSESSMENT MODULE

➔ **OBSERVER INSTRUCTIONS:** Record what you hear or see during the HSA's examination.  
Circle "Yes" for all problems mentioned. Select "No" for all problems not mentioned.

##### A1. What problems does the caregiver state the child has?

- |                                   |                |
|-----------------------------------|----------------|
| A. Fast or difficult breathing    | (1) Yes (2) No |
| B. Cough                          | (1) Yes (2) No |
| C. Pneumonia                      | (1) Yes (2) No |
| D. Diarrhoea (loose stools)       | (1) Yes (2) No |
| E. Fever                          | (1) Yes (2) No |
| F. Malaria                        | (1) Yes (2) No |
| G. Convulsions                    | (1) Yes (2) No |
| H. Sleepy or unconscious          | (1) Yes (2) No |
| I. Difficulty drinking or feeding | (1) Yes (2) No |
| J. Vomiting                       | (1) Yes (2) No |
| K. Red eyes                       | (1) Yes (2) No |
| L. Other, specify .....           | (1) Yes (2) No |

➔ **OBSERVER INSTRUCTIONS:** *If any of the following have already been mentioned by the caregiver, select "Yes". Otherwise, select "Yes" if the HSA asks or checks for the item. If the HSA does not ask or check for the item, select "No", or if a question is not applicable, select "NA".*

*If prompted for a number of days or number of breaths per minute, type the number into the tablet. If the caregiver does not know the number of days, type "98". If you cannot determine the number of breaths per minute that the HSA counts, type "98" and then complete after reviewing the iCCM protocol guide used by the HSA.*

No.	Observe:	Response:
A2	Does the HSA ask if the child has cough?	(1) Yes (2) No
A3	→ If child has cough, does the HSA ask for how long?	(1) Yes (2) No (7)
A4	Number of days?	NA Days: .....
A5	Does the HSA ask if the child has diarrhoea (loose stools)?	(1) Yes (2) No
A6	→ If child has diarrhoea, does the HSA ask for how long?	(1) Yes (2) No (7)
A7	Number of days?	NA Days: .....
A8	Does the HSA ask if there is blood in the stool?	(1) Yes (2) No
A9	Does the HSA ask if the child has fever (reported or now)?	(1) Yes (2) No
A10	→ If child has fever, does the HSA ask for how long?	(1) Yes (2) No (7)
A11	Number of days?	NA Days: .....
A12	Does the HSA ask if the child has convulsions or history of convulsions?	(1) Yes (2) No
A13	Does the HSA ask if the child has difficulty drinking or feeding?	(1) Yes (2) No
A14	→ If the child has difficulty, does the HSA ask if the child is NOT able to drink or feed ANYTHING?	(1) Yes (2) No (7) NA
A15	Does the HSA ask if the child is vomiting?	(1) Yes (2) No
A16	→ If the child is vomiting, does the HSA ask if the child is vomiting EVERYTHING?	(1) Yes (2) No (7) NA
A17	Does the HSA ask if the child has red eyes?	(1) Yes (2) No
A18	→ If the child has red eyes, does the HSA ask for how long?	(1) Yes (2) No (7)
A19	Number of days?	NA Days: .....
A20	Does the HSA ask if the child has difficulty seeing?	(1) Yes (2) No
A21	Does the HSA look for chest in-drawing?	(1) Yes (2) No
A22	Does the HSA count breaths in 1 minute?	(1) Yes (2) No (7) NA
A23	Breaths per minute (BPM)?	BPM: .....
A24	Is the child visibly awake (smiling, playing, crying with energy)?	(1) Yes (2) No
A25	→ If no, does the HSA check for sleepiness or unconsciousness (try to wake up the child)?	(1) Yes (2) No (7) NA
A26	Does the HSA look for palmar pallor?	(1) Yes (2) No
A27	For a child 6 – 59 months, does the HSA check for MUAC tape colour?	(1) Yes (2) No (7)
A28	Colour?	NA
A29	Does the HSA look for swelling of both feet?	(1) Yes (2) No
A30	Does the HSA ask if there are any "other problems"?	(1) Yes (2) No

**A31. Does the HSA determine an mRDT is needed?**

- (1) Yes  
(2) No

District: \_\_\_\_\_ Facility: \_\_\_\_\_ HSA ID: \_\_\_\_\_ Child No.: \_\_\_\_\_

**A32. Does the evaluator determine an mRDT is needed?**

- (1) Yes
- (2) No → *Skip to A35*

**A33. Does the HSA perform an mRDT?**

- (1) Yes
- (2) No, mRDT supplies are out of stock → *Skip to A35*
- (3) No, other: specify ..... → *Skip to A35*

**A34. What is the result of the mRDT?**

- (1) Positive
- (2) Negative

→ **OBSERVER INSTRUCTIONS:** *Do not ask Question A35. Only observe.*

**A35. [Observe only] Does the HSA record any information in his or her village clinic register during the encounter with the child?**

- (1) Yes
- (2) No

→ **OBSERVER INSTRUCTIONS:** *Leave the exam area with the HSA after the HSA finishes his or her assessment.*

## B. CLASSIFICATION MODULE

→ **OBSERVER INSTRUCTIONS:** *Complete the classification table below outside of the exam area. Select “Yes” or “No” for each classification, as marked in the HSA's Village Clinic Register or Sick Child Recording Form, or as displayed on the mobile application screen. Only danger signs—the items starred in the columns on the left—will appear on the mobile application screen.*

No.	Classification	Response
*B1.A	Cough for 14 days or more	(1) Yes (2) No (7) NA
*B2.A	Chest indrawing	(1) Yes (2) No
B3.A	Fast breathing	(1) Yes (2) No
*B4.A	Diarrhoea for 14 days or more	(1) Yes (2) No (7) NA
*B5.A	Blood in stool	(1) Yes (2) No
B6.A	Diarrhoea less than 14 days and no blood in stool	(1) Yes (2) No (7) NA
*B7.A	Fever for 7 days or more	(1) Yes (2) No (7) NA
B8.A	Fever for less than 7 days	(1) Yes (2) No (7) NA
*B9.A	Convulsions	(1) Yes (2) No
*B10.A	Not able to drink or feed anything	(1) Yes (2) No
*B11.A	Vomits everything	(1) Yes (2) No
*B12.A	Red eye for 4 days or more	(1) Yes (2) No (7) NA
*B13.A	Visual problem	(1) Yes (2) No
B14.A	Red eye for less than 4 days	(1) Yes (2) No (7) NA
*B15.A	Very sleepy or unconscious	(1) Yes (2) No

District: \_\_\_\_\_ Facility: \_\_\_\_\_ HSA ID: \_\_\_\_\_ Child No.: \_\_\_\_\_

*B16.A	Palmar pallor	(1) Yes (2) No
*B17.A	Swelling of both feet	(1) Yes (2) No
*B18.A	Red on MUAC tape	(1) Yes (2) No
*B19.A	Yellow on MUAC tape	(1) Yes (2) No
B20.A	Green on MUAC tape	(1) Yes (2) No
*B21.A	Other problem, refer Specify.....	(1) Yes (2) No

## C. TREATMENT MODULE

**C1. Does the HSA decide to refer to a health facility?**

- (1) Yes  
(2) No

**C2. Does the HSA decide to prescribe treatment?**

- (1) Yes  
(2) No → Skip to C4

**C3. Select each treatment the HSA prescribes, assuming that there are no stockouts of any medicines at the village clinic. If the HSA does not prescribe the treatment, enter “0”.**

	Treatment	Formulation	Total number of tablets, sachets or tubes
A.	LA	Tablets	
B.	Amoxicillin	Tablets	
C.	ORS	Sachets	
D.	Zinc	Tablets	
E.	Paracetamol	Tablets	
F.	Eye ointment	Tubes	
G.	Rectal artesunate	Suppository	
H.	Other, specify .....	Other, specify .....	

**C4. Does the evaluator determine that the child needs to be referred to a health facility?**

- (1) Yes  
(2) No

## D. COMMUNICATION MODULE

**OBSERVER INSTRUCTIONS:** Complete this module in the exam room while observing the HSA complete the sick child consultation, after the evaluator confirms the correct classifications and treatments.

**For children being treated at home, start at D1.**

**For children referred, start at D11.**

**For children not treated and not referred, start at D7.**

District: \_\_\_\_\_ Facility: \_\_\_\_\_ HSA ID: \_\_\_\_\_ Child No.: \_\_\_\_\_

→ **Note: Questions D1 to D6 refer to counseling that the HSA provides on administration of treatment for sick children who can be treated at home. For D6, total amount given to the child's caregiver, enter "96" if the HSA could not give the treatment because it was out of stock.**

**D1-D5. Does the HSA ...?**

	Treatment	D1. Prescribe the treatment ?	D2. Explain how to give the treatment?			D3. Demonstra te how to give the treatment?	D4. Ask the caregiver to repeat back how to give the treatment?	D5. Give or ask the caregiver to give the first dose right away?	D6. Record total number of (X) given to the child's caregiver
			A. Dose	B. Frequency	C. Duration				
A.	LA (tablets)	(1) Yes (2) No	(1) 1 tablet (2) 2 tablets (3) Other	(1) 2 times per day (2) Other	(1) 3 days (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	
B.	Amoxicillin (250 mg tablets)	(1) Yes (2) No	(1) 1 tablet (2) 2 tablets (3) Other	(1) 2 times per day (2) Other	(1) 5 days (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	
C.	ORS (sachets)	(1) Yes (2) No	(1) At least ½ cup (2) Other	(1) After each loose stool (2) Other	(1) Until diarrhea is gone (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	
D.	Zinc (tablets)	(1) Yes (2) No	(1) ½ tablet (2) 1 tablet (3) Other	(1) 1 time per day (2) Other	(1) 10 days (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	
E.	Paracetamol (tablets)	(1) Yes (2) No	(1) ¼ tablet (2) ½ tablet (3) Other	(1) 4 times per day (2) Other	(1) 3 days (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	
F.	Antibiotic eye ointment (tubes)	(1) Yes (2) No	(1) amount size of grain of rice (2) Other	(1) 3 times per day (2) Other	(1) 3 days (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	
G.	Rectal artesunate (suppository)	(1) Yes (2) No	(1) 1 suppository (2) 2 suppositories (3) Other	(1) 1 time (2) Other	(1) N/A (2) Other	(1) Yes (2) No	(1) Yes (2) No	(1) Yes (2) No	

District: \_\_\_\_\_ Facility: \_\_\_\_\_ HSA ID: \_\_\_\_\_ Child No.: \_\_\_\_\_

**D7. Does the HSA advise on home care?**

- (1) Yes  
(2) No → *Skip to question D9*

**D8. Circle “(1) Yes” for all advice given by the HSA. Circle “(2) No” if the HSA does not give that advice:**

- |   |                |
|---|----------------|
| A. Give more fluids and continue feeding                            | (1) Yes (2) No |
| B. Go to health facility/return if the child cannot drink or feed   | (1) Yes (2) No |
| C. Go to health facility/return if child becomes sicker             | (1) Yes (2) No |
| D. Go to health facility/return if the child has blood in the stool | (1) Yes (2) No |
| E. Use of ITN   | (1) Yes (2) No |
| F. Other, specify.....  | (1) Yes (2) No |
| G. Other, specify.....  | (1) Yes (2) No |
| H. Other, specify.....  | (1) Yes (2) No |

**D9. Does the HSA ask to see the child's vaccination card (health passport)?**

- (1) Yes  
(2) No

**D10. Does the HSA advise on when to return for follow-up?**

- (1) Yes  
(2) No

→ **OBSERVER INSTRUCTIONS:** Ask D11 and D12 only if child is being referred to a health facility.

**D11. For a child being referred, does the HSA explain the need for referral?**

- (1) Yes  
(2) No

**D12. For a child being referred, does the HSA do the following:**

- |   |                |        |
|---|----------------|--------|
| A. For any sick child who can drink, advise to give fluids and continue feeding | (1) Yes (2) No | (7) NA |
| B. Advise to keep child warm, if child is NOT hot with fever                    | (1) Yes (2) No | (7) NA |
| C. Write a referral note  | (1) Yes (2) No | (7) NA |
| D. Arrange transportation   | (1) Yes (2) No |        |
| E. Other, specify.....  | (1) Yes (2) No |        |

**END OF OBSERVATION FOR CASE**

**Tool B: Evaluator Re-exam Checklist**

➔ **EVALUATOR INSTRUCTIONS:** In the Assessment Information column, if the child does not have a certain illness (i.e. cough, diarrhoea, fever, or red eye), enter “0” for number of days. If you cannot determine the child’s breaths per minute, enter “98”.

Use the Notes column to keep track of any classification information that did not match the HSA’s classification so that you can review the correct classifications with him or her. (The information from the Notes column will not be entered into the data collection tablet.)

No.	Assessment Information	No.	Classification	Response	Does not agree with HSA (v)	Notes
A4.B	Cough: Number of days _____	B1.B	Cough for 14 days or more	(1) Y (2) N		
		B2.B	Chest indrawing	(1) Y (2) N		
A23.B	Breaths per minute _____	B3.B	Fast breathing (2-11mo: 50+bpm; 12-59mo: 40+bpm)	(1) Y (2) N		
A7.B	Diarrhoea Number of days _____	B4.B	Diarrhoea for 14 days or more	(1) Y (2) N		
		B5.B	Blood in stool	(1) Y (2) N		
		B6.B	Diarrhoea less than 14 days and no blood in stool	(1) Y (2) N		
A11.B	Fever: Number of days _____	B7.B	Fever for 7 days or more	(1) Y (2) N		
		B8.B	Fever for less than 7 days	(1) Y (2) N		
		B9.B	Convulsions	(1) Y (2) N		
A13.B	Difficulty drinking/feeding (1) Y (2) N	B10.B	Not able to drink or feed anything	(1) Y (2) N		
A15.B	Vomits (1) Y (2) N	B11.B	Vomits everything	(1) Y (2) N		
A19.B	Red eye: Number of days _____	B12.B	Red eye for 4 days or more	(1) Y (2) N		
		B13.B	Visual problem	(1) Y (2) N		
		B14.B	Red eye for less than 4 days	(1) Y (2) N		
		B15.B	Very sleepy or unconscious	(1) Y (2) N		
		B16.B	Palmar pallor	(1) Y (2) N		
		B17.B	Swelling of both feet	(1) Y (2) N		
		B18.B	Color on MUAC tape	(1) Red (2) Yellow (3) Green (7) N/A (8) Tape not available		
		B21.B	Other problem, refer Specify.....	(1) Y (2) N		

## APPENDIX 3: HSA QUESTIONNAIRE

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For office use

### ICF RAcE Malawi mHealth Evaluation 2016 Tool C. HSA Questionnaire

Consent form read and accepted: ☐ Yes

A HSA IDENTIFICATION		
#	Question	Response
A1	District:	[Select one] 1 =Dedza 2 = Mzimba 3 = Ntcheu 4 = Ntchisi 5 = Lilongwe 6 = Nkhatabay 7 = Rumphi
A2	Health center that the HSA reports to:	[Select one: dynamic list dependent on district selected]
A3	Village clinic name:	[Select one: dynamic list dependent on health center selected]
A4	HSA name:	[Verify information]
A5	HSA contact number:	[Verify information]
A6	HSA supervisor name:	[Type HSA's response into tablet]
A7	Interview date (Day / Month / Year):	<input type="text"/> / <input type="text"/> / 2016

B HSA BACKGROUND		
#	Question	Response
B1	HSA's sex	Male .....1 Female.....2
B2	How old are you?	Age (years) ..... <input type="text"/> <input type="text"/>
B3	What is the highest education you have completed?	Primary school .....1 Form two.....2 Form four (MSCE) .....3 Other (specify on next screen).....7
B4	How long have you been providing iCCM services as an HSA?  (If less than 1 year, enter "0".)	Years..... <input type="text"/> <input type="text"/>



B5	<p>Where do you see sick children? That is, what kind of place is your village clinic?</p> <p><i>(Probe if needed.)</i></p>	<p>In his or her home</p> <p>.....</p> <p>1</p> <p>In a room attached or next to home</p> <p>.....</p> <p>2</p> <p>In a room not attached or not next to home</p> <p>.....</p> <p>3</p> <p>Outside under a tree or under a shaded area</p> <p>.....</p> <p>4</p> <p>Other (specify on next screen)</p> <p>.....</p> <p>7</p>
B6	<p>On most days, how do you travel from the village clinic to the health facility?</p>	<p>Walk .....1</p> <p>Bicycle .....2</p> <p>Motorbike .....3</p> <p>Vehicle.....4</p> <p>Other (specify on next screen).....7</p>
B7	<p>On most days, how long does it take you to travel from the village clinic to the health facility?</p>	<p>Less than 30 minutes .....1</p> <p>30 minutes to less than 1 hour .....2</p> <p>1 hour to less than 2 hours .....3</p> <p>2 or more hours .....4</p>
B8	<p>On most days, do you live in the catchment area where the village clinic is located?</p> <p><i>(‘Live’ means it is the HSA’s primary residence.)</i></p>	<p>Yes .....1</p> <p>No .....2</p>

B9	On most days, how long does it take you to travel from where you live to the village clinic location?	Live in or next door to clinic.....1 Less than 30 minutes .....2 30 minutes to less than 1 hour .....3 1 hour to less than 2 hours .....4 2 or more hours .....5
B10	In the past 7 days, how many days did you operate the village clinic?	# of days per week: <input type="text"/>
B11	In the past 7 days, how many hours, in total, did you operate the village clinic?	# hours in past 7 days: <input type="text"/>
B12	In the past month, how many days did you report for duties at the health facility?	# days in past month: <input type="text"/>
B13	On most days during the rainy season, how many sick children between the ages of 2 months to 59 months do you see per day?	Most days, per day: <input type="text"/>
B14	On most days during the dry season, how many sick children between the ages of 2 months to 59 months do you see per day?	Most days, per day: <input type="text"/>

<b>C</b>	<b>iCCM TRAINING</b>																	
<b>#</b>	<b>Question</b>	<b>Response</b>																
<b>INTERVIEWER READ OR SAY:</b> The next questions are about iCCM training that you may have received. This training is specific to delivering iCCM services and does not include any additional training you may have received on using mobile phone applications for iCCM.																		
C1	When was your last training in iCCM?	Month ..... <input type="text"/> <input type="text"/> Year ..... <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>																
C2	What kind of iCCM training was it?	Initial iCCM training ..... 1 Refresher iCCM training..... 2 Other (specify on next screen)..... 7																
C3	During your most recent training, did you learn how to use the following tools to collect and report data?	<table border="1"> <thead> <tr> <th>Item</th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>A. Sick child recording form</td> <td>1</td> <td>2</td> </tr> <tr> <td>B. Village clinic register</td> <td>1</td> <td>2</td> </tr> <tr> <td>C. Referral slip</td> <td>1</td> <td>2</td> </tr> <tr> <td>D. Form 1A</td> <td>1</td> <td>2</td> </tr> </tbody> </table>		Item	Yes	No	A. Sick child recording form	1	2	B. Village clinic register	1	2	C. Referral slip	1	2	D. Form 1A	1	2
Item	Yes	No																
A. Sick child recording form	1	2																
B. Village clinic register	1	2																
C. Referral slip	1	2																
D. Form 1A	1	2																
	<i>Read each item.</i>																	

D CASE MANAGEMENT		
<b>INTERVIEWER READ OR SAY:</b> The next questions I would like to ask you are about the tools that you use when you see sick children.		
D1	<p>In the past month, what tools have you used to guide you when you see sick children?</p> <p><i>Do not read response options. Select all that are mentioned.</i></p>	<p>Sick Child Recording Form ..... A</p> <p>Village Clinic Register ..... B</p> <p>iCCM mobile application ..... C</p> <p>Referral slip..... D</p> <p>Other (specify on next screen) ..... X</p>
D1F	<p>Check question A1: What district does the HSA work in?</p> <p>(1) Dedza, (2) Mzimba North, (3) Ntcheu, or (4) Ntchisi → Go to D2F</p> <p>(5) Lilongwe, (6) Nkhatabay, (7) Rumphi →Go to D3F</p>	
D2F	<p>Check Question D1: Is “iCCM mobile application, response option (C), selected?</p> <p>Yes → Go to Question D4.</p> <p>No → Go to Question D2.</p>	
D2	Why don't you use the iCCM mobile application to guide you?	<p>[Type HSA's response into tablet.] &gt;&gt; Skip to D4</p>
D3F	<p>Check Question D1: Is “Sick Child Recording Form”, response option (A) selected?</p> <p>Yes → Go to Question D4.</p> <p>No → Go to Question D3.</p>	
D3	Why don't you use the Sick Child Recording Form to guide you?	[Type HSA's response into tablet.]
D4	How do these tools that you use help you when you see sick children?	[Type HSA's response into tablet.]
D5F	<p>Check question D2: Is “Sick Child Recording Form,” response option (A), selected?</p> <p>Yes → Go to Question D5.</p> <p>No → Go to Question D6F.</p>	
D5	On a scale of 1 to 5, with 1 being very difficult and 5 being very easy, how easy to use is the SICK CHILD RECORDING FORM as a guide when you see sick children?	<p>Very difficult ..... 1</p> <p>Difficult ..... 2</p> <p>Neither difficult nor easy..... 3</p> <p>Easy ..... 4</p> <p>Very easy ..... 5</p>
D6F	<p>Check question D2: Is “Village Clinic Register,” response option (B), selected?</p> <p>Yes → Go to Question D6.</p> <p>No → Go to Question D7.</p>	

D6	On a scale of 1 to 5, with 1 being very difficult and 5 being very easy, how easy to use is the VILLAGE CLINIC REGISTER as a guide when you see sick children?	Very difficult ..... 1 Difficult ..... 2 Neither difficult nor easy..... 3 Easy ..... 4 Very easy ..... 5
D7	Have you experienced any challenges in following the iCCM assessment guidelines?	Yes ..... 1 No ..... 2  > > S ki p t o D 1 O F
D8	Please briefly describe the challenges. (Probe regarding: assessing, classifying, providing recommended referral or treatment to sick children)	[Type HSA's response into tablet.]
D9	What recommendations would you make to overcome or minimize these challenges?	[Type HSA's response into tablet.]
D10 F	Check question D2: Is “iCCM mobile application,” response option (C), selected?  Yes → Go to Question D10. No → Go to Question E1.	
D10	On a scale of 1 to 5, with 1 being not useful and 5 being extremely useful, how useful is your mobile phone in managing sick children?	Not useful ..... 1 A little useful ..... 2 Somewhat useful..... 3 Very useful..... 4 Extremely useful..... 5
D11	How has the application affected how you provide services to children, if at all?	[Type HSA's response into tablet.]

E DATA COLLECTION, REPORTING AND USE		
<b>INTERVIEWER READ OR SAY:</b> Now I would like to ask you about the tools that you use to collect and report data. I'll start with how you collect data during your sick child assessments.		
E1	<p>In the past month, what tools have you used to record your assessments of sick children?</p> <p><i>Do not read response options. Select all that are mentioned.</i></p>	<p>Sick Child Recording Form ..... A</p> <p>Village Clinic Register..... B</p> <p>iCCM mobile application..... C</p> <p>Referral slip..... D</p> <p>Piece of paper ..... E</p> <p>Other (specify on next screen) ..... X</p>
E2	<p>In the past month, when have you usually recorded information in the village clinic register?</p> <p><i>(Select all responses that are mentioned.)</i></p>	<p>During a consultation ..... A</p> <p>Right after a consultation ..... B</p> <p>At the end of the day ..... C</p> <p>Other (specify on next screen) ..... X</p>
E3F	<p>Check question E2: Is more than one response option selected?</p> <p>Yes → Go to Question E3.</p> <p>No → Go to Question E4.</p>	
E3	Why do you sometimes record information in your Village Clinic Register at different times?	[Type HSA's response into tablet.]
E4F	<p>Check question E2: Is "During a consultation," response option (A) selected?</p> <p>Yes → Go to Question E6.</p> <p>No → Go to Question E4.</p>	
E4	During the past month, if you did not enter information into your Village Clinic Register while you were seeing a sick child, how often did you record those cases in your register at a later time?	<p>Not at all ..... 1</p> <p>Less than 50% of the time ..... 2</p> <p>50% of the time ..... 3</p> <p>More than 50% of the time ..... 4</p> <p>Every time ..... 5</p> <p>&gt;&gt;Skip to E6</p> <p>Not applicable..... 6</p> <p>&gt;&gt;Skip to E6</p>
E5	Why don't you record all cases in your Village Clinic Register?	[Type HSA's response into tablet.]

E6	On a scale of 1 to 5, with 1 being very difficult and 5 being very easy, how easy to use is the Village Clinic Register to record information for each sick child you see?	Very difficult ..... 1 Difficult ..... 2 Neither difficult nor easy ..... 3 Easy ..... 4 Very easy ..... 5
E7	Why do you feel that way?	[Type HSA's response into tablet.]
<b>INTERVIEWER READ OR SAY:</b> Now I would like to ask you some questions about the iCCM data that you report to the health center using the HSA monthly reporting form, Form 1A.		
E8	On a scale of 1 to 5, with 1 being very difficult and 5 being very easy, how easy to use is Form 1A?	Very difficult ..... 1 Difficult ..... 2 Neither difficult nor easy ..... 3 Easy ..... 4 Very easy ..... 5
E9	Why do you feel that way?	[Type HSA's response into tablet.]
E10	Most months, how long does it take you to fill out Form 1A?	Less than 30 minutes ..... 1 30 minutes to less than 1 hour ..... 2 1 hour to less than 2 hours ..... 3 More than 2 hours ..... 4
E11	Most months, how do you submit Form 1A to the health facility?	On foot ..... 1 By bicycle ..... 2 By vehicle ..... 3 By courier/other person ..... 4 Senior HSA gets it at village clinic ..... 5 By phone ..... 6 Other (specify on next screen) ..... 7
E12	During the past year, how many months have you experienced delays in submitting Form 1A to the health center, if at all?	Never ..... 0 >>> Skip to E14  # of months with delays..... <input type="text"/> <input type="text"/>

E13	<p>What causes the delays?</p> <p><i>Do not read response options. Select all that are mentioned.</i></p>	<p>Weather ..... A</p> <p>Lack of transport ..... B</p> <p>Takes too much time ..... C</p> <p>Too busy ..... D</p> <p>Other (specify on next screen) ..... X</p>
E14	<p>What do you do with the data that you collect?</p> <p><i>Do not read response options. Select all that are mentioned.</i></p> <p><i>Probe for data use.</i></p>	<p>Record it in village clinic register ..... A</p> <p>Tally it monthly in Form</p> <p>1A ..... B</p> <p>.....</p> <p>Submit data via phone ..... C</p> <p>Display it in my village clinic ..... D</p> <p>Talk about it with community members ... E</p> <p>Make decisions ..... F</p> <p>Other (specify on next screen) ..... X</p>
E15 F	<p>Check question E15: Is "Talk about it with community members," response option (E), selected?</p> <p>Yes → Go to Question E15.</p> <p>No → Go to Question E16F.</p>	
E15	Please give an example of the data that you shared and who you talked to in your community.	[Type HSA's response into tablet.]
E16 F	<p>Check question E15: Is "Make decisions," response option (F), selected?</p> <p>Yes → Go to Question E16.</p> <p>No → Go to Question F1.</p>	
E16	Please give an example of a decision that you made using iCCM data.	[Type HSA's response into tablet.]

<b>F</b>	<b>SUPERVISION</b>	
<p><b>INTERVIEWER READ OR SAY:</b> The next questions are about supervision and mentoring that you have received related to your iCCM work.</p>		
F1	<p>During the past 3 months, how many times did you receive a supervisory visit in your community specific to iCCM, if at all?</p>	<p>No CCM supervision visits ..... 0 &gt;&gt;</p> <p><i>Skip to F5</i></p> <p># CCM supervision visits: ..... <input type="text"/></p>



F2	<p>Who supervised you during the most recent visit?</p> <p><i>Do not read response options. Select all that are mentioned.</i></p>	IMCI Coordinator..... A IMCI Trainer/Facilitator ..... B Senior HSA..... C Environmental Health Officer ..... D Medical Assistant from Health Centre ..... E Save the Children/NGO staff member ..... F Community Nurse ..... G Pharmacy technician ..... H D-tree staff/mobile app support..... I Other (specify on next screen) ..... X																										
F3	<p>During the most recent supervision visit did the supervisor do any of the following:</p> <p><i>Read each item. If the HSA is unsure select "No" for that item.</i></p>	<table border="1"> <thead> <tr> <th>Item</th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>A. Review your village clinic register?</td> <td>1</td> <td>2</td> </tr> <tr> <td>B. Check your supplies and equipment levels?</td> <td>1</td> <td>2</td> </tr> <tr> <td>C. Use a supervision checklist?</td> <td>1</td> <td>2</td> </tr> <tr> <td>D. Administer a case scenario?</td> <td>1</td> <td>2</td> </tr> <tr> <td>E. Observe you manage a sick child?</td> <td>1</td> <td>2</td> </tr> <tr> <td>F. Meet with village committee members?</td> <td>1</td> <td>2</td> </tr> <tr> <td>G. Give you feedback on your iCCM activities?</td> <td>1</td> <td>2</td> </tr> </tbody> </table>	Item	Yes	No	A. Review your village clinic register?	1	2	B. Check your supplies and equipment levels?	1	2	C. Use a supervision checklist?	1	2	D. Administer a case scenario?	1	2	E. Observe you manage a sick child?	1	2	F. Meet with village committee members?	1	2	G. Give you feedback on your iCCM activities?	1	2		
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F4F	<p>Check questions D1 and E1: Is "iCCM mobile application," response option (C), selected for one or both questions?</p> <p>Yes → Go to Question F4.</p> <p>No → Go to Question F5.</p>																											
F4	<p>During the most recent supervision visit did the supervisor also check to see if you're having trouble with your phone or the mobile application?</p>	<p>Yes ..... 1</p> <p>No ..... 2</p>																										
F5	<p>During the past 3 months, how many times have you received mentoring sessions at your health center, if at all?</p>	<p>No CCM mentoring sessions.....0</p> <p>&gt;&gt;&gt;&gt; Go to Question G1</p> <p># CCM mentoring sessions ..... <input type="text"/></p>																										

F6	During your most recent mentoring session, did the mentor do any of the following:  <i>Read each item.</i>	<b>Item</b>	<b>Yes</b>	<b>No</b>
		A. Use a mentoring checklist?	1	2
		B. Observe you manage a sick child?	1	2
		C. Demonstrate how to care for a sick child or identify danger signs?	1	2
		D. Give you feedback on your case management skills?	1	2

G MEDICINE AND SUPPLIES																																											
<b>INTERVIEWER READ OR SAY:</b> Now I'd like to ask you about your iCCM medicines and supplies and then about the sick child referrals that you make.																																											
G1	During the past 12 months, where have you gone to get your medications, supplies, and equipment?  <i>(If necessary probe to determine if the place is a public or private facility – or somewhere else.)</i>	Public facility ..... 1 Private facility ..... 2 Other (specify on next screen)..... 7																																									
G2	What is currently in your drug box?  <i>Check the HSA's drug box and record if the HSA has <u>at least one full set of each of item available in his/her stocks.</u></i>  <i>Note: The minimum amount for each item is shown in parentheses.</i>	<table border="1"> <thead> <tr> <th>Item</th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>A. LA (1x6) (1 blister packet)</td> <td>1</td> <td>2</td> </tr> <tr> <td>B. LA (2x6) (1 blister packet)</td> <td>1</td> <td>2</td> </tr> <tr> <td>C. Rapid diagnostic test (2 tests)</td> <td>1</td> <td>2</td> </tr> <tr> <td>D. Rectal artesunate (2 suppositories)</td> <td>1</td> <td>2</td> </tr> <tr> <td>E. Amoxicillin (1 blister pack)</td> <td>1</td> <td>2</td> </tr> <tr> <td>F. Cotrimoxazole (10 tablets)</td> <td>1</td> <td>2</td> </tr> <tr> <td>G. ORS (3 sachets)</td> <td>1</td> <td>2</td> </tr> <tr> <td>H. Zinc (10 tablets)</td> <td>1</td> <td>2</td> </tr> <tr> <td>I. Paracetamol (6 tablets)</td> <td>1</td> <td>2</td> </tr> <tr> <td>J. Eye antibiotic (1 tube)</td> <td>1</td> <td>2</td> </tr> <tr> <td>K. Timer (1 functional)</td> <td>1</td> <td>2</td> </tr> <tr> <td>L. Gloves</td> <td>1</td> <td>2</td> </tr> </tbody> </table>	Item	Yes	No	A. LA (1x6) (1 blister packet)	1	2	B. LA (2x6) (1 blister packet)	1	2	C. Rapid diagnostic test (2 tests)	1	2	D. Rectal artesunate (2 suppositories)	1	2	E. Amoxicillin (1 blister pack)	1	2	F. Cotrimoxazole (10 tablets)	1	2	G. ORS (3 sachets)	1	2	H. Zinc (10 tablets)	1	2	I. Paracetamol (6 tablets)	1	2	J. Eye antibiotic (1 tube)	1	2	K. Timer (1 functional)	1	2	L. Gloves	1	2		
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G3	In the past month, have you experienced stockouts lasting 7 or more days of any of the following?	<table border="1"> <thead> <tr> <th>Item</th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>A. LA (1x6)</td> <td>1</td> <td>2</td> </tr> <tr> <td>B. LA (2x6)</td> <td>1</td> <td>2</td> </tr> <tr> <td>C. Rapid diagnostic test (mRDT)</td> <td>1</td> <td>2</td> </tr> <tr> <td>D. Rectal artesunate</td> <td>1</td> <td>2</td> </tr> <tr> <td>E. Amoxicillin</td> <td>1</td> <td>2</td> </tr> <tr> <td>F. ORS</td> <td>1</td> <td>2</td> </tr> <tr> <td>G. Zinc</td> <td>1</td> <td>2</td> </tr> </tbody> </table>	Item	Yes	No	A. LA (1x6)	1	2	B. LA (2x6)	1	2	C. Rapid diagnostic test (mRDT)	1	2	D. Rectal artesunate	1	2	E. Amoxicillin	1	2	F. ORS	1	2	G. Zinc	1	2																	
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F. ORS	1	2																																									
G. Zinc	1	2																																									

		H. Paracetamol	1	2
		I. Eye antibiotic	1	2
G4 F	Check question G3: are all the response options “No”? Yes → Go to Question H1. No → Go to Question G4.			
G4	What are the main reasons that you experience stockouts?  <i>Do not read response options. Select all that are mentioned.</i>	Health facility did not have enough supply to send me ..... A National-level stockout ..... B Weather; could not travel to health center ..... C Schedule; could not travel to health center ..... D Lack of transport; could not travel to health center ..... E Other (specify on next screen) ..... X		

H MOBILE PHONE OWNERSHIP		
#	Question	Response
<b>INTERVIEWER READ OR SAY:</b> Now I'd like to ask you a few questions about mobile phone use in your iCCM work.		
H1	Were you trained on the iCCM mobile application?	Yes..... 1 No.....2 >>>> Skip to I1
H2	When were you trained on the iCCM mobile application?	Month..... <input type="text"/> <input type="text"/> Year..... <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
H3	Before your training, did you have any experience using a smart phone, or phone that allows you to access the internet (like the one you use for iCCM)?	Yes ..... 1 No ..... 2 >>>> Skip to H5
H4	Please describe that experience ( <i>Probe for amount to type of phone, length of time and frequency</i> )	[Type HSA's response into tablet.]
H5	Do you use the same phone or a different phone for reporting your medicine stocks to cStock?	Same ..... 1 Different ..... 2

I MOBILE APPLICATION							
#	Question	Response					
I1F	Check questions D1 and E1: Is "iCCM mobile application," response option (C), selected for one or both questions?  Yes → Go to Question I1.  No → End interview.						
I1	On a scale of 1 to 5, with 1 being very difficult and 5 being very easy, how easy are the following?  <i>Repeat the scale as you read each item.</i>		Very diff	Difficult	Neither	Easy	Very easy
	A. Logging into the app	1	2	3	4	5	
	B. Navigating through screens	1	2	3	4	5	
	C. Submitting your data	1	2	3	4	5	

		D. Using the mobile application every time you manage a sick child	1	2	3	4	5																																										
		E. Understanding the guiding information and instructions in the application	1	2	3	4	5																																										
		F. Overall use of mobile app	1	2	3	4	5																																										
I2	How often do you experience the following issues?  <i>(Read each item. Do not read response options, but if necessary probe.)</i>  Never: 0 times Rarely: < 1 time per month Sometimes: 1+ time per month Often: 1+ time per week Always: Every time app is used	<table border="1"> <thead> <tr> <th>Item</th><th>Never</th><th>Rarely</th><th>Sometimes</th><th>Often</th><th>Always</th></tr> </thead> <tbody> <tr> <td>A. Connectivity issues when trying to submit data</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr> <td>B. No airtime to submit data</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr> <td>C. Phone battery does not stay charged</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr> <td>D. Cannot charge phone</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr> <td>E. Phone malfunctions or breaks</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr> <td>F. Lost or stolen phone</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> </tbody> </table>	Item	Never	Rarely	Sometimes	Often	Always	A. Connectivity issues when trying to submit data	0	1	2	3	4	B. No airtime to submit data	0	1	2	3	4	C. Phone battery does not stay charged	0	1	2	3	4	D. Cannot charge phone	0	1	2	3	4	E. Phone malfunctions or breaks	0	1	2	3	4	F. Lost or stolen phone	0	1	2	3	4					
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F. Lost or stolen phone	0	1	2	3	4																																												
I3	Are there any other issues that you experience that I did not mention?	Yes..... 1 No..... 2																																															
I3o	What are the other issues?	[Type HSA's response into tablet.]																																															
I3F	Check questions D1: Is "iCCM mobile application," response option (C), selected? Yes → Go to Question I3. No → Go to Question I5.																																																
I4	What do you do when your phone is not working or out of battery and a sick child comes for care – do you use another tool to guide the assessment? What tool do you use?  <i>Do not read response options, but if necessary probe.</i> <i>Select all that are mentioned.</i>	I never have this problem ..... 1 >>> <i>Skip to I8</i> Yes, the child using the Sick Child Recording Form..... 2 Yes, the child using the Village Clinic Register..... 3 No, I examine the child without a tool to guide me ..... 4 No, I do not examine the child ..... 5 Other (specify on next screen) ..... 7																																															

15	What do you do when your phone is not working or out of battery and a sick child comes for care – where do you record the information during the assessment?	In my Village Clinic Register ..... 1 On a Sick Child Recording Form ..... 2 On a piece of paper ..... 3 I do not record the information..... 4 Other (specify on next screen) ..... 7
16	When your phone is working again, how often do you enter the information for sick children you saw while your phone was not working?	Not at all ..... 1 Less than 50% of the time ..... 2 50% of the time ..... 3 More than 50% of the time ..... 4 Every time ..... 5 >>Skip to 18 Not applicable ..... 6 >>Skip to 18
17	Why don't you always enter the data into your phone?	[Type HSA's response into tablet.]
18	How do you top up mobile data to use the app?  <i>Do not read response options, but if necessary probe. Select all that are mentioned. Can also substitute "units" for "top up."</i>	I receive a standard amount of mobile data credit every month. 1 I ask for mobile data credit when I need it, and it is provided ..... 2 I buy mobile data credit when I need it, and I am reimbursed .... 3 I buy mobile data credit when I need it, but I am not reimbursed4 Other (specify on next screen) ..... 7
19	Where do you get support when you have issues?  <i>Do not read response options. Select all that are mentioned.</i>	Mobile application help desk..... A Peer support group ..... B Supervisor ..... C Other (specify on next screen) ..... X

## APPENDIX 4: QUALITY OF CARE INDICATORS

**Table 1. Key Quality of Care Indicators**

Key Indicators (A=Assessment, =Classification; T=Treatment; R=Referral)	Definition of Numerator	Definition of Denominator
A1a. Proportion of children checked for presence of cough	Number of sick children observed whose caretakers were asked for presence of cough	Number of sick children observed
A1b. Proportion of children checked for presence of diarrhea	Number of sick children observed whose caretakers were asked for presence of diarrhea	Number of sick children observed
A1c. Proportion of children checked for presence of fever	Number of sick children observed whose caretakers were asked for presence of fever	Number of sick children observed
A2. Proportion of children with cough assessed for presence of fast breathing through counting of respiratory rates	Number of sick children observed with cough who had respiratory rate counted by HSA	Number of sick children observed with cough
A3. Proportion of children with fever assessed for malaria with a rapid diagnostic test	Number of sick children observed with fever/history of fever assessed for malaria with a rapid diagnostic test	Number of sick children observed with fever/history of fever
A4. Proportion of children checked for three general danger signs (i.e., not able to drink/BF/eat, vomits everything, has convulsions)	Number of sick children observed who are checked for three general danger signs (i.e., not able to drink/BF/eat, vomits everything, has convulsions)	Number of sick children observed
A5. Proportion of sick children assessed for five physical danger signs (i.e., chest indrawing; sleepy or unconscious, palmar pallor; red on MUAC tape; swelling of both feet)α , overall and disaggregated by danger sign	Number of sick children observed who are assessed for five physical danger signs (i.e., chest indrawing; sleepy or unconscious, palmar pallor; red on MUAC tape; swelling of both feet)	Number of sick children observed
A6. Proportion of cases of children with cough assessed for the presence of fast breathing in which HSA counted respiratory rate within +/- 3 breaths of gold standard (iCCM trainer)	Number of cases of children observed with cough assessed for the presence of fast breathing in which HSA counted respiratory rate within +/- 3 breaths of gold standard (iCCM trainer)	Number of cases of children with cough in which respiratory rate was assessed
C1. Proportion of children whose classifications given by HSA match all the classifications given by IMCI-trained clinician/evaluator	Number of sick children observed with validated classifications for whom classifications for the main symptoms given by HSA match all the validated classifications	Number of sick children observed with validated classifications
C2. Proportion of children whose classifications for the three common illnesses (malaria [positive mRDT], diarrhea and cough with fast breathing) given by HSA match the classifications given by IMCI- trained clinician/evaluator	Number of sick children observed with validated classifications for whom classifications for three common illnesses (malaria [positive mRDT], diarrhea and cough with fast breathing) given by HSA match the validated classifications	Number of sick children observed with validated classifications
T1. Proportion of children with cough and fast breathing and/or positive mRDT and/or diarrhea who are correctly prescribed all medications (antibiotic and/or antimalarial and/or ORS and zinc) for their illness(es) ‡	Number of sick children observed, with validated classifications, not needing referral, with cough and fast breathing, positive mRDT and/or diarrhea who are correctly prescribed an oral antibiotic, antimalarial and/or ORS and zinc, including correct dose, frequency and duration	Number of sick children observed with validated classifications not needing referral, who need an oral antibiotic, antimalarial and/or ORS and zinc



Key Indicators (A=Assessment, =Classification; T=Treatment; R=Referral)	Definition of Numerator	Definition of Denominator
T2. Proportion of children with cough and fast breathing who are prescribed an antibiotic correctly‡	Number of sick children observed, with validated classifications, not needing referral, with cough and fast breathing who are correctly prescribed an oral antibiotic, including correct dose, frequency and duration	Number of sick children observed with validated classifications not needing referral, who need an oral antibiotic
T3a. Proportion of children with fever and positive mRDT who are prescribed an antimalarial (ACT) correctly‡	Number of sick children observed, with validated classifications, not needing referral, who have positive mRDT who are correctly prescribed an antimalarial, including correct dose, frequency and duration	Number of sick children observed with validated classifications not needing referral, who need an antimalarial
T3b. Proportion of children with fever and negative mRDT who are prescribed an antimalarial (ACT)‡	Number of sick children observed, with validated classifications, not needing referral, who have fever/history of fever but negative mRDT who are incorrectly prescribed an antimalarial	Number of sick children observed with validated classifications, and a negative mRDT result not needing referral or an antimalarial
T4. Proportion of children with diarrhea who are prescribed ORS and zinc correctly‡	Number of sick children observed, with validated classifications, not needing referral, with diarrhea who are correctly prescribed ORS and zinc, including correct dose, frequency and duration	Number of sick children observed with validated classifications not needing referral, who need ORS and zinc
T5. Proportion of children without cough and fast breathing who would have left the HSA without having received an antibiotic‡	Number of sick children observed, with validated classifications, not needing referral, who do not need an oral antibiotic for cough and fast breathing who would have left HSA without antibiotic	Number of sick children observed with validated classifications not needing referral, who do not need an oral antibiotic for cough and fast breathing
T6. Proportion of children who need an antibiotic, ORS and zinc, and/or antimalarial who receive the correct first dose in presence of HSA‡	Number of sick children observed, with validated classifications, not needing referral, who need oral antibiotic, antimalarial and/or ORS and zinc and received the first dose of all needed drugs in presence of HSA	Number of sick children observed with validated classifications not needing referral, who need antibiotic, antimalarial and/or ORS and zinc
R1. Proportion of children with danger signs needing referral who are referred	Number of sick children observed with validated classifications needing referral due to the presence of one or more danger signs ** who were referred	Number of sick children observed with validated classifications needing referral due to the presence of one or more danger signs**

**Notes:** ‡ Children 2-5 months only assessed for 3 physical danger signs (MUAC only assessed for children 6 months and older); hence, A24=N/A for children 2-5 months of age ‡ among children not presenting with danger signs and requiring referral; \*\*Includes: 1) cough for 21 days or more; 2) diarrhea for 14 days or more; 3) Blood in stool; 4) Fever for last 7 days; 5) Convulsions; 6) Child not able to drink or feed anything; 7) Red eye for 4 days or more; 8) Red eye with visual problems; 9) Chest in-drawing; 10) Very sleepy or unconscious; 11) Palmar pallor; 12) Red on MUAC tape; 13) Swelling of both feet; 14) Other problem HSAs cannot treat

Source: Adapted from Johns Hopkins University, 2009. Quality of Care Provided to Sick Children by Health Surveillance Assistants in Malawi: Final Report; Health Facility Survey: Tool to evaluate the quality of care delivered to sick children attending outpatient facilities. Geneva: Dept. of Child and Adolescent Health and Development, WHO, 2003.

## APPENDIX 5: DATA QUALITY ASSESSMENT INDICATORS

Table 1. Key Quality of Data Indicators

Dimension of Quality	Key Indicators	Definition of Numerator	Definition of Denominator
1. Availability	<p>1.a. <u>VHC Registers</u>: Proportion of active HSAs whose VHC register is available for review for months assessed</p> <p>1.b. <u>HSA Reports</u>: Proportion of active HSAs whose monthly summary reports are available for review for months assessed</p> <p>1.c. <u>Mobile</u>: Proportion of active HSAs using the mobile app whose data are available in the D-tree database for months assessed</p>	<p><u>VHC Registers</u>: Number of active HSAs whose VHC register is available for review for months assessed</p> <p><u>HSA Reports</u>: Number of active HSAs whose monthly summary reports are available for review for months assessed</p> <p><u>Mobile</u>: Number of active HSAs using the mobile app whose data are available in the D-tree database for months assessed</p>	<p><u>VHC Registers</u>: Number of active HSAs whose VHC register is expected for review for months assessed</p> <p><u>HSA Reports</u>: Number of active HSAs whose monthly summary reports are expected for review for months assessed</p> <p><u>Mobile</u>: Number of all active HSAs using the mobile app whose data are expected in the D-tree database for months assessed</p>
2. Completeness	<p>2.a. <u>VHC Registers</u>: Proportion of VHC register entries that have all fields completed, disaggregated by register sections (background info, assessment, classification, treatment and referral) for months assessed</p> <p>2.b. <u>HSA Reports</u>: Proportion of monthly summary reports that have all fields completed, disaggregated by form sections (background info, new cases, referrals, totals, supervision, supply management table) for months assessed</p> <p>2.c. <u>Mobile</u>: Proportion D-tree database entries that have all fields completed, disaggregated by VHC register sections (background info, assessment, classification, treatment and referral) for months assessed</p>	<p><u>VHC Registers</u>: Number of VHC register entries that have all fields completed by register sections for months assessed</p> <p><u>HSA Reports</u>: Number of monthly summary reports that have all fields completed by form sections for months assessed</p> <p><u>Mobile</u>: Number of entries in the D-tree database that have all fields completed by register sections for months assessed</p>	<p><u>VHC Registers</u>: Total number of VHC register entries reviewed for months assessed</p> <p><u>HSA Reports</u>: Total number of monthly summary reports reviewed for months assessed</p> <p><u>Mobile</u>: Number of entries reviewed in the D-tree database for months assessed</p>

Dimension of Quality	Key Indicators	Definition of Numerator	Definition of Denominator
3a. Consistency¥	<b>Consistency ratios</b> 3.a. <u>Register/Reporting Form</u> : Ratio of counts verified in VHC registers to counts reported in HSA monthly summary reports for months assessed, by data field and HSA	<u>Register/Reporting Form</u> : Sum of counts verified in VHC registers for months assessed	<u>Register/Reporting Form</u> : Sum of counts reported in HSA monthly summary reports for months assessed
	3.b. <u>Register/Mobile App</u> : Ratio of counts verified in VHC registers to counts in D-tree database for months assessed, by data field and HSA	<u>Register/Mobile App</u> : Sum of counts verified in VHC register for months assessed	<u>Register/Mobile App</u> : Sum of counts in D-tree database for months assessed
	<b>Total number of entries</b> 3.c. <u>Register/Mobile App</u> : Difference between the number of entries in D-tree database and the number of entries in VHC registers, by HSA		
	<b>Count differences</b> 3.d. <u>Register/Reporting Form</u> : Difference between the counts recorded in HSA monthly summary report and the counts verified in VHC registers, by data field and HSA  3.e. <u>Register/Mobile App</u> : Difference between the counts in D-tree database and the counts verified in the VHC registers, by data field and HSA		

¥ Consistency is a measure of accuracy, as explained in the Methodology section

## APPENDIX 6: DATA QUALITY ASSESSMENT TOOLS

Village Clinic Register Review Instructions				
Field	Description	Instructions		Register data fields
A	Background	Background section of register entry is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes: (1) date, (2) child's name, (3) age, (4) sex, (5) caregiver's name, (6) relationship, (7) address, (8) village, (9) TA (Rows 1 & 2 of entry, except follow-up box)
B	Assessment	Assessment section of register entry is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes: all "Identify Problem Ask?" and "Identify Problem Look?" fields (Rows 3 & 4 of entry, except vaccination field)
C	Classification	Classification section of register entry is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes: "Danger sign (Ask?)" boxes, "Danger sign Look" box, "Sick but no danger sign" box, and "Decide: refer or treat child (tick decision)" box
D	Treatment and referral (Tx & Refer)	Treatment and referral sections of register entry are complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes: "Prepare for referral" box, "Treat at home" boxes, and "Advise - home care" box
E	Follow-up	Follow-up section of register entry is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes: "Follow up" and "Date" fields
F	ALL	Number of sections that are complete	Sum of above fields (Min = 0, Max = 5)	
G	mRDT	Positive mRDT treat at home case	1 = LA field checked in the <i>Treat at Home</i> section	- LA 5 months up to 3 yrs (6 tabs) <b>OR</b> - LA 3 yrs up to 5 yrs (12 tabs)
H	Fast breathing	Fast breathing treat at home case	1 = Amoxicillin field checked in the <i>Treat at Home</i> section	- Amoxicillin 2 months up to 12 months (10 tabs) <b>OR</b> - Amoxicillin 12 months up to 5 yrs (20 tabs)
I	Diarrhea	Diarrhea treat at home case	1 = ORS or zinc fields checked in the <i>Treat at Home</i> section	- ORS 3 pkts <b>AND/OR</b> - Zinc 2 months up to 6 months (5 tabs) <b>OR</b> - Zinc 6 months up to 5 yrs (10 tabs)
J	Referral-DS	Referral with danger sign case	1 = If <i>ANY danger sign refer</i> field checked in the <i>Decide</i> section	- If ANY danger sign refer
K	Notes	Data collection team notes	Use this field to keep track of issues or questions that come up	

Village Clinic Register Tracker MONTH 1 / 2											Date
District					Facility					HSA Code	
	Section (1 = Complete, 0 = Incomplete)					Treatment (1 = Recorded)					K Comments
	A	B	C	D	E	F	G	H	I	J	
Case	Background	Assessment	Classification	Tx & Refer	Follow-up	ALL	mRDT+	FB	Diarrhea	Refer-DS	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
Total											

Village Clinic Register Tracker MONTH 1 / 2			
Field	Description	Instructions	Form 1A (Excel)
Background information section is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes all fields above the CM Cases report summary section	Rows 3-7
New cases section is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes all fields in the New Cases section of the CM Cases report summary	Rows 12-22, Columns B-E
Referrals sections are complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes all fields in the Referrals with danger signs & Referrals made because of Drug stockout sections of the CM Cases report summary	Rows 12-22, Columns F-M
Deaths section is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes all fields in the Deaths section of the CM Cases report summary	Rows 12-22, Columns N-Q
Grand totals section is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	- Grand total (Total Fever + Total other cases) - New Cases by gender Males - New Cases by gender Females	- E23 - H23 - L23
Supplies management table is complete	0 = Not all fields in section filled in 1 = All fields in section filled in	Includes all fields above the Supply Management Table	Rows 29-39
Supervision and mentorship fields are complete	0 = Not all fields in section filled in 1 = All fields in section filled in	- How many times were you supervised in the month - How many times were you mentored in the month	- D41 - M41
Form is signed by approving officer	0 = No, form is not signed 1 = Yes, form is signed	- Name of Approving officer - Signature	- B42 - H42
Entire form is complete	0 = Not all fields in form filled in 1 = All fields in form filled in	- All fields	
Total number of fast breathing new cases	Record the total number of fast breathing new cases on each form.	- Fast breathing New cases	- E17
Total number of positive mRDT new cases	Record the total number of positive mRDT new cases on each form.	- Confirmed Malaria cases with mRDT test (mRDT Positive) New cases	- E13
Total number of diarrhea new cases	Record the total number of diarrhea new cases on each form.	- Diarrhoea New cases	- E16
Total number of referrals with danger signs	Record the total number of referrals with danger signs on each form.	- TOTALS Referrals with danger signs	- I22
Total number of cases (New cases + Referrals)	Sum the reported counts of New cases, Referrals with danger signs, and Referrals made because of drug stockout.	- TOTALS New cases <b>AND</b> - TOTALS Referrals with danger signs <b>AND</b> - TOTALS Referrals made because of drug stockout	- E22 - I22 - M22
Number of new cases - Males	Record the total number of New cases by gender Males on each form.	- New cases by gender Males	- H23
Number of new cases - Females	Record the total number of New cases by gender Females on each form.	- New cases by gender Females	- L23

<b>Village Clinic Register Tracker MO</b>		<b>Date</b>	
<b>Facility</b>		<b>HSA Code</b>	
<b>COMPLETENESS (Record: 1 = Complete, 0 = Incomplete)</b>			
		<b>Month 1</b>	<b>Month 2</b>
A	Background information section is complete		
B	New cases section is complete		
C	Referrals sections are complete		
D	Deaths section is complete		
E	Grand totals section is complete		
F	Supplies management table is complete		
G	Supervision and mentorship fields are complete		
H	Form is signed by approving officer		
I	Entire form is complete		
<b>TALLIES (Record: Tally for month. If data field is blank, enter "M".)</b>			
		<b>Month 1</b>	<b>Month 2</b>
J	Total number of fast breathing new cases		
K	Total number of positive mRDT new cases		
L	Total number of diarrhea new cases		
M	Total number of referrals with danger signs		
N	Total number of cases (New cases + Referrals)		
O	Number of new cases - Males		
P	Number of new cases - Females		

RAcE mHealth Evaluation: Data Quality Assessment Data Collection Tool					
Background Information					
District	[Select from list] 1 = Dedza    2 = Mzimba    3 = Ntcheu    4 = Ntchisi				
Facility	[Select from list]				
HSA/Village Clinic	[Select from list]				
Date (Day / Month / Year):	□□/□□/2016				
Month 1	Month 2	Instructions		Data fields	Excel cell
Register					
1	Total number of entries		Count the total number of entries for each month in the VHC register. (Can be auto-calculated from the Register Tracker, so we can omit this from the data collection sheet.)		
2	Number of complete entries		Auto-calculated from rows 18-22 (So can omit in data collection sheet.)		
3	Number of entries with background information section complete		Count the total number of entries that have all background information fields filled in or marked for each month.	Includes: (1) date, (2) child's name, (3) age, (4) sex, (5) caregiver's name, (6) relationship, (7) address, (8) village, (9) TA (Rows 1 & 2 of entry, except follow-up box)	
4	Number of entries with assessment section complete		Count the total number of entries that have all assessment fields filled in or marked for each month.	Includes: all "Identify Problem Ask?" and "Identify Problem Look?" fields (Rows 3 & 4 of entry, except vaccination field)	
5	Number of entries with classification section complete		Count the total number of entries that have all classification fields filled in or marked for each month.	Includes: "Danger sign (Ask?)" boxes, "Danger sign Look" box, "Sick but no danger sign" box, and "Decide: refer or treat child (tick)"	
6	Number of entries with treatment/referral section complete		Count the total number of entries that have all treatment fields filled in or marked for each month.	Includes: "Prepare for referral" box, "Treat at home" boxes, and "Advise - home care" box	
7	Number of entries with follow-up section complete		Count the total number of entries that have follow-up fields filled in or marked for each month.	Includes: "Follow up" and "Date" fields	
8	Verified count of fast breathing treat at home		Count the total number of entries that have an Amoxicillin field checked in the <i>Treat at Home</i> section for each month.	- Amoxicillin 2 months up to 12 months (10 tabs) <b>OR</b> - Amoxicillin 12 months up to 5 yrs (20 tabs)	
9	Verified count of positive mRDT treat at home		Count the total number of entries that have an LA field checked in the <i>Treat at Home</i> section for each month.	- LA 5 months up to 3 yrs (6 tabs) <b>OR</b> - LA 3 yrs up to 5 yrs (12 tabs)	
10	Verified count of diarrhea treat at home		Count the total number of entries that have the ORS and/or a zinc field checked in the <i>Treat at Home</i> section for each month.	- ORS 3 pkts <b>AND/OR</b> - Zinc 2 months up to 6 months (5 tabs) <b>OR</b> - Zinc 6 months up to 5 yrs (10 tabs)	
11	Verified count of referrals with danger signs		Count the total number of entries that have the <i>If ANY danger sign refer</i> field checked in the <i>Decide</i> section for each month.	- If ANY danger sign refer	
Form 1A					
12	Background information section is complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	Includes all fields above the CM Cases report summary section	Rows 3-7
13	New cases section is complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	Includes all fields in the New Cases section of the CM Cases report summary	Rows 12-22, Columns B-E
14	Referrals sections are complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	Includes all fields in the Referrals with danger signs & Referrals made because of Drug stockout sections of the CM Cases report summary	Rows 12-22, Columns F-M
15	Deaths section is complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	Includes all fields in the Deaths section of the CM Cases report summary	Rows 12-22, Columns N-Q
16	Grand totals section is complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	- Grand total (Total Fever + Total other cases) - New Cases by gender Males - New Cases by gender Females	- E23 - H23 - L23
17	Supplies management table is complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	Includes all fields above the Supply Management Table	Rows 29-39
18	Supervision and mentorship fields are complete		1=Yes, all fields are filled in in section; 0=No, not all fields are filled in in section	- How many times were you supervised in the month - How many times were you mentored in the month	- D41 - M41
19	Form is signed by approving officer		1=Yes, form is signed; 0=No, form is not signed	- Name of Approving officer - Signature	- B42 - H42
20	Form is complete		Auto-calculated from Rows 33-40		
21	Total number of fast breathing new cases		Record the total number of fast breathing new cases on each form.	- Fast breathing New cases	- E17
22	Total number of positive mRDT new cases		Record the total number of positive mRDT new cases on each form.	- Confirmed Malaria cases with mRDT test (mRDT Positive) New cases	- E13
23	Total number of diarrhea new cases		Record the total number of diarrhea new cases on each form.	- Diarrhoea New cases	- E16
24	Total number of referrals with danger signs		Record the total number of referrals with danger signs on each form.	- TOTALS Referrals with danger signs	- I22
25	Total number of cases (New cases + Referrals)		Sum the reported counts of New cases, Referrals with danger signs, and Referrals made because of drug stockout.	- TOTALS New cases <b>AND</b> - TOTALS Referrals with danger signs <b>AND</b> - TOTALS Referrals made because of drug stockout	- E22 - I22 - M22
26	Number of new cases - Males		Record the total number of New cases by gender Males on each form.	- New cases by gender Males	- H23
27	Number of new cases - Females		Record the total number of New cases by gender Females on each form.	- New cases by gender Females	- L23



## APPENDIX 7: CAREGIVER INTERVIEW GUIDE (ENGLISH)

### Evaluation of the Use of mHealth Application in the iCCM Program in Malawi

#### Tool D. Caregiver Interview Guide

A	Background information	
#	Question	Response
A1	District (circle one):	[Select one from list] 1 =Dedza 2 = Mzimba 3 = Ntcheu 4 = Ntchisi 5 = Lilongwe 6 = Nkhatabay 7 = Rumphi
A2	Facility:	[Select one from list]
A3	Village clinic/HSA:	[Select one from list]
A4	Interview date (Day / Month / Year):	□□ / □□ / 2016
A5	Child number:	□□□
A6	Caregiver's name:	
A7	Caregiver's sex:	1=Male 2=Female
A8	Caregiver's relationship to child:	1=Mother 2=Father 3=Other, specify on next screen
A9	How old are you?	Age in completed years: □□
A10	Have you ever attended school?	1=Yes 2=No <i>Skip to Question A13</i>
A11	What is the highest level of school you attended: primary, secondary, or higher?	1=Primary 2=Secondary 3=Higher
A12	What is the highest (standard/form/year) you completed at that level?	□□
A13	How many children under-five do you take care of?	□

## B. Caregiver care-seeking

B1. Is this your first time visiting a village clinic?

- ☐ Yes
- ☐ No >>>> *Skip to B3A*

B2. How many times have you visited a village clinic in past 6 months? \_\_\_\_\_

B3. A. Do you know on which days the village clinic is open?

- ☐ Yes
- ☐ No >>> Skip to B4

B3B. Which days is the village clinic open?

- ☐ Caregiver states correct days
- ☐ Caregiver does not state correct days

B4. How do you usually travel to this village clinic?

*Note to interviewer: Do not read responses; if multiple modes are mentioned, probe to determine the mode most often used.*

1. Walk
2. Bicycle
3. Motorbike
4. Vehicle
5. Other (specify): \_\_\_\_\_

B5. How long does it take you to travel from your home to this village clinic?

1. Less than 30 minutes
2. 30 minutes to less than 1 hour
3. 1 hour to less than 2 hours
4. 2 hours or more

B6. How do you usually travel to the health center?

- A. Walk
- B. Bicycle
- C. Motorbike
- D. Vehicle
- E. Other (specify): \_\_\_\_\_
- F. Do not go to the health center >>>> *Skip to C1*

B7. How long does it usually take for you to travel from home to the nearest health center?

1. Less than 30 minutes
2. 30 minutes to less than 1 hour
3. 1 hour to less than 2 hours
4. 2 hours or more

## C. General perceptions of village clinic and HSA

Do you agree or disagree with the following statements?

*Note to interviewer: If respondent is unsure, circle "Don't know".*

Statement	Agree	Neither agree nor disagree	Disagree	Don't know
C1. People in my community know about the village clinic.	1	2	3	8
C2. The HSA's village clinic is nearby.	1	2	3	8
C3. It is easy to find the HSA when he or she is needed.	1	2	3	8
C4. When my child is sick, I go to the HSA first for treatment.	1	2	3	8
C5. Medicines are always available at the village clinic.	1	2	3	8
C6. The HSA gives medicines that are good quality.	1	2	3	8
C7. The HSA conducts follow-up visits for sick children.	1	2	3	8
C8. I go to the village clinic for treatment of my sick children because it takes less time than going to the health center.	1	2	3	8
C9. I go to the village clinic for treatment of my sick children because it costs less than going to the health center.	1	2	3	8
C10. I trust in the HSA's ability to treat sick children.	1	2	3	8
C11. I go to the village clinic for treatment of my sick children because I trust the village clinic more than the health center.	1	2	3	8
C12. If an HSA refers my child to a health center, I comply with the referral.	1	2	3	8

## D. Community awareness and data use

D1. Have you ever seen the HSA or other people present graphs, charts or numbers about a health problem in your community?

- ☐ Yes
- ☐ No >>>> *Skip to Question D5*

D2. What was it about?

D3. Did you and the other community members think that the information you received was important? Why?

D4. Is there anything else about child illnesses that you wish the HSA would share with you and your community?

*Note to interviewer: Skip to Question D7 after asking Question D4.*

D5. Is there anything about child illnesses that you wish the HSA would share with you and your community?

☐ Yes

☐ No >>>> *Skip to Question D7*

D6. What? Please give an example.

D7. How can awareness of services available at the village clinic be increased in your community?

## E. This instance of care-seeking (Today's visit to the HSA)

E1. Why did you choose to come to this village clinic to get care for your sick child?

*Note to interviewer: Do not read responses; select all that are mentioned.*

- A. Nearby
- B. Free services
- C. Good reputation
- D. Knows HSA
- E. Services/medicines available
- F. Referred by someone
- G. Other, specify \_\_\_\_\_

*Note to interviewer: If the respondent only gives one reason for E1, skip to Question E3.*

E2. From the reasons you listed, what was the main reason that you came?

*Note to interviewer: Select letter from Question E1*

.....  
☐

E3-E11: On a scale of 1-3 (1=satisfied, 2=neither satisfied nor dissatisfied, and 3=dissatisfied), how satisfied are you with the following?

Statement	Satisfied	Neither	Dissatisfied	Don't know
E3. Opening hours of the village clinic?	1	2	3	8
E4. Cleanliness of the village clinic?	1	2	3	8
E5. Length of waiting time at the village clinic?	1	2	3	8
E6. Friendliness and respect received from the HSA?	1	2	3	8
E7. Privacy of consultation at the village clinic?	1	2	3	8
E8. Care provided by the HSA?	1	2	3	8
E9. The way the HSA took time to explain your child's illness and the treatment he or she needs?	1	2	3	8
E10. Advice on home care provided by HSA?	1	2	3	8
E11. Overall experience at the village clinic?	1	2	3	8

E12. Do you feel confident that you can correctly administer the treatments that the HSA gave you for your child?

- ☐ Yes
- ☐ No
- ☐ Don't know

E13. Please describe how you would administer each of the treatments at home.

*Note to Interviewer: Can the caregiver correctly describe how to administer the treatments? Listen to the caregiver's descriptions, and mark the box that is appropriate, based on the caregiver's descriptions.*

- ☐ Yes, the caregiver can correctly administer all treatments
- ☐ Partly, the caregiver can correctly administer some treatments
- ☐ No, the caregiver cannot correctly administer any of the treatments

E14. Would you recommend the village clinic to a friend?

- ☐ Yes
- ☐ No
- ☐ Don't know

E15. What recommendations would you make to improve the care you and your children get from the village clinic?

## F. Mobile application

*Note to Interviewer: Only ask Questions F1 and F2 at village clinics where the mobile application was used.*

F1. Do you feel that the quality of care that you receive from the HSA is better when they use the mobile application?

- ☐ Yes
- ☐ No
- ☐ Don't know

F2. Why do you think so?

**THANK YOU!**

## APPENDIX 8: CAREGIVER INTERVIEW GUIDE (CHICHEWA)

### Evaluation of the Use of mHealth Application in the iCCM Program in Malawi

#### Caregiver Interview Guide

A	MBIRI	
#	Mfunso	Yankho
A1	Boma (zungulizani imodzi):	1 =Dedza 2 = Mzimba 3 = Ntcheu 4 = Ntchisi 5 = Lilongwe 6 = Nkhatabay 7 = Rumphu
A2	Chipatala:	[Zungululizani chimodzi pa ndandanda]
A3	Chipatala cha m'mudzi/Mlangizi wazaumoyo:	[Zungululizani chimodzi pa ndandanda]
A4	Tsiku la macheza (tsiku / Mwezi / Chaka):	□□ / □□ / 2016
A5	Nambala ya mwana:	□□□
A6	Dzina la mlezi:	
A7	Mlezi ndi Wamamuna/Wamkazi:	1=Wamamuna 2=Wamkazi
A8	Ubale wa Mlezi kwa mwana:	1=Mayi 2=Bambo 3=Zina, lembani

A9	Muli ndi zaka zingati ?	Zaka zonse zokwanila: □□
A10	Munayamba mwapitako kusukulu?	1=Eya 2=Ayi skip to A 13
A11	Sukulu munapita nayo patali bwanji: pulayimale, sekondale, kapena kauchenjede?	1=Pulaimale 2=Kondale 3=Kauchenjede
A12	Kodi Kalasi (sitandade/folomu/chaka) yaikulu yomwe munamaliza ndi chani?	□□
A13	Kodi ndi ana angati osapitilila zaka zisanu amene mukusamalira?	□

### B. KUFUNA CHISAMARILO

B1. Kodi ndikoyamba kubwera kuchipatala cha m'mudzi?

- ☐ Eya  
☐ Ayi >>>> *pitani pa funso B3*

B2. Mwapitako kuchipatala cha m'mudzi kangati pa miyezi isanu ndi umodzi (6) yapitayi? \_\_\_\_\_

B3. A Mumadziwa masiku amene chipatala cha m'mudzi chimakhala chotsekula?

Inde

Ayi skip to B4

B3B Ndimasiku ati omwe chipatala cha m'mudzi chimakhala chotsekula?

*Chidziwitso kwa ofunsa: ngati mlezi wavomela, funsitsani kuti mudziwe za masiku.*

- ☐ Mlezi wayankha eya, ndipo wapeleka masiku oyenela
- ☐ Mlezi wayankha eya, koma sanapeleke masiku woyenela

B4. Kodi mumayenda bwanji popita kuchipatala cha m'mudzichi nthawi zambiri?

*Chidziwitso kwa ofunsa: musawerenge mayankho; ngati njira zingapo zantchulidwa funsitsani kuti mudziwe za njira imene imagwiritsidwa ntchito kwambiri*

6. Kuyenda
7. Njinga
8. Njinga ya moto
9. Galimoto
10. Zina (tchulani): \_\_\_\_\_

B5. Kodi zimakutengerani nthawi yaitali bwanji kuchoka kunyumba kwanu kudzafika kuchipatala cha m'mudzi chino?

- Kuchepera mphindi makumi atatu
- Kuchokera pa mphindi makumi atatu koma osapitilila ola limodzi
- Kuchokera pa ola limodzi koma osapitilira ma ola awiri
- Maola awiri kupita mtsogolo

B6. Nthawi zambiri mumayenda bwanji kupita kuchipatala chaching'ono?

*Chidziwitso kwa ofunsa: osawelenga mayankho; sankhani zonse zomwe zanenendwa.*

- A. Wapansi
- B. Njinga
- C. Njinga yamoto
- D. Galimoto
- E. Zina (tchulani): \_\_\_\_\_
- F. Sindimapita kuchipatala chaching'ono >>>> pitani ku C1

B7. Nthawi zambiri, zimakutengerani nthawi yaitali bwanji kuchoka kunyumba kupita kuchipatala chaching'ono chapafupi?

*Chidziwitso kwa ofunsa: ngati mwapeza mayankho ochuluka pa funso B5, lembani nthawi ya yankho lililonse.*



## C. ZOKHUDZA CHIPATALA CHA M'MUDZI NDI ALANGIZI AZA UMOYO

Kodi mukuvomeleza kapena kusavomeleza ndi ziganizo zotsatilazi?

*Chidziwitsao kwa ofunsa: ngati oyankha akukaikila, zungulizani “sindikudziwa”.*

Chiganizo	Ndikuvomel ezana nazo	Ndili pakatikati	Sindikuvomel ezana nazo	sindikudziwa
C1. Anthu amdela lathu amadziwa za chipatala cha m'mudzi.	1	2	3	8
C2. Chipatala cha m'mudzi cha alangizi a za umoyo chili pafupi.	1	2	3	8
C3. Nkosavuta kuwapeza alangizi a za umoyo pamene iwo akufunika.	1	2	3	8
C4. Mwana wanga akadwala ndimayamba ndapita naye kwa alangizi a za umoyo kukapeza chithandizo.	1	2	3	8
C5. Mankhwala amapezeka nthawi zonse ku chipatala cha m'mudzi.	1	2	3	8
C6. A langizi a za umoyo amapeleka mankhwala abwino.)	1	2	3	8
C7. Alangizi a za umoyo amapanga kalondolondo wa ana odwala.	1	2	3	8
C8. Ndimapita ku chipatala cha m'mudzi kukafuna chithandizo cha ana akadwala chifukwa sizitenga nthawi kusiyana ndikupita ku chipatala chaching'ono.	1	2	3	8
C9. Ndimapita kuchipatala cha m'mudzi kukafuna chithandizo cha ana akadwala chifukwa sizimatilowa nthumba kusiyana ndikupita chipatala chaching'ono.	1	2	3	8
C10. Ndili ndi chikhulupiro mukuthekela kwa a langizi a za umoyo pakupeleka thandizo kwa ana odwala.	1	2	3	8
C11. Ndimapita ku chipatala cha m'mudzi kukafuna chithandizo cha ana anga odwala chifukwa ndili ndi chikhulupiro pa chipatala cha m'mudzichi kusiyana ndi chipatala chaching'ono.	1	2	3	8
C12. Ngati a langizi a za umoyo atumiza mwana wanga kuchipatala chaching'ono ine ndimatsatira zimene anenazo.	1	2	3	8

## D. ZOKHUDZA MDERA NDIKAGWIRITSIDWE NTCHITO ZA KALEMBERA ZOMWE ANTHU AMAZIWA PANKHANI ZAUMOYO

D1. Kodi munawonapo alangizi a za umoyo kapena anthu ena akupeleka zotsatila za mavuto a za umoyo pogwiritsa ntchito zinthuzi kapena manambala m'dela lanu lino?

- ☐ Eya
- ☐ Ayi >>>> *pitani pa funso D5*

D2. Kodi zimenezi zinali zokhudza chani?

D3. Kodi inu kapena anthu ena a m'dela lino munaganiza kuti uthenga umenewu unali ofunikila? Ngati ndi choncho, ndichifukwa chani?

D4. Pali zinanso zokhudzana ndi matenda a ana zimene mumafuna azaumoyo atagawana nanu komanso anthu a m'dera lanu?

*Chidziwitsao kwa ofunsa: pitani pa funso D7 mukafunsa funso D4.*

D5. Pali zinanso zokhudzana ndi matenda a ana zimenene mumafuna a zaumoyo atagawana nanu komanso anthu am'dela lanu lino?

- ☐ Eya
- ☐ Ayi >>>> *pitani pa funso D7*

D6. Ngati ndi choncho ndi zinthu zANJI? Chonde pelekani chitsanzo

D7. Kodi pangachitike chani kuti chidziwitso cha zisamaliro zomwe zimapezeka ku chipatala cha m'mudzi chichulukile m'dela lanu?

## E. ZACHISAMARILO CHA LERO

*(Note to Interviewer: This section is regarding 'Today's visit to the HSA')*

E1. Ndi chifukwa chani munasankha kudza funa chithandizo cha mwana wanu odwala ku chipatala cha m'mudzi chino?

*Chidziwitso kwa ofunsa: musawerenge mayankho; sankhani zonse zimene zatchulidwa*

- H. Ndipafupi
- I. Chithandizo chawulele
- J. Mbili yabwino
- K. Kudziwana ndi a zaumoyo
- L. Kupezeka kwa chithandizo komanso mankhwala

- M. Ndinatumizidwa ndi munthu  
N. Zina , tchulani \_\_\_\_\_

*Chidziwitsa kwa ofunsa: ngati oyankha apeleka chifukwa chimodzi pa funso E1, pitani pa funso E3.*

E2. Pa zifukwa zimene mwapelekazi, chifukwa cheni cheni chimene munabwerera ndi chiti?

*Chidziwitso kwa ofunsa: sankhani liwu pa funso E1*

.....  
☐

Pa muyeso oyambila 1 mpaka 3 (1=okhutitsidwa, 2=pakatikati, and 3=osakhutitsidwa) ndinu okhutitsidwa bwanji ndi zotsatilazi?

Statement	okhutitsidwa	pakatikati	osakhutitsidwa	sindikudziwa
E3. Nthawi yotsegulila chipatala cha m'mudzi?	1	2	3	8
E4. Ukhondo wa pa chipatala cha m'mudzi?	1	2	3	8
E5. Kutalika kwa nthawi yodikilila ku chipatala cha m'mudzi?	1	2	3	8
E6. Ulemu ndi nsangala kuchoka kwa alangizi a za umoyo?	1	2	3	8
E7. Kasungidwe ka chinsinsi powonana ndi alangizi azaumoyo	1	2	3	8
E8. Chisamaliro kuchoka kwa alangizi a za umoyo?	1	2	3	8
E9. M'mene a langizi a za umoyo amatengela nthawi yawo kufotokoza za matenda ndi chithandizo kwa mwana wanu?	1	2	3	8
E10. Uphungu wa chisamaliro cha ku nyumba kuchokela kwa a langizi a za umoyo?	1	2	3	8
E11. Kagwilidwe ntchito ka chipatala cha m'mudzi?	1	2	3	8

E12. Kodi mumadzikhulupilila kuti mukhoza kupeleka chithandizo kwa mwana wanu momwe a langizi a za umoyo akuwuzilani?

- ☐ Eya  
☐ Ayi  
☐ Sindikudziwa

E13. Fotokozani momwe mungapelekere zithandizo zimenezi kunyumba.

*Chidziwitsao kwa ofunsa: kodi mlezi akhonza kufotokoza za momwe chithandizo chimapelekedwela moyenela? Mvetselani zomwe mlezi wafotokoza, ndipo lembani pa malo olondola mogwilizana ndi zomwe mlezi wafotokoza.*

- ☐ Inde, mlezi angathe kupeleka zithandizo zonse moyenela  
☐ Pang'ono, mlezi angathe kupeleka zithandizo zina moyenela  
☐ Ayi , mlezi sangathe kupeleka zithandizo zonse moyenela

E14. Mungawalimbikitse anzanu kuti adzipita ku chipatala cha m'mudzi?

- ☐ Eya
- ☐ Ayi
- ☐ Sindikudziwa

E15. Ndi malangizo anji amene mungapeleke kuti chisamalilo chimene inu ndi ana anu mumalandila ku chipatala cha m'mudzi chipite patsogolo?

## F. Mauthenga azaumoyo a pa lamya ya manja

*Chidziwitso kwa ofunsa: Funsani mafunso F1 ndi F2 pa zipatala za m'mudzi zokhazo zimene kwa zimagwilitsa ntchito ma uthenga a pa lamya.*

F1. Kodi mukuganiza kuti chisamalilo chimene mumalandila kuchoka kwa a langizi a za umoyo chimakhala cha bwino akamagwilitsa ntchito lamya ya manja kapena akamalemba m'mabuku ?

- ☐ Eya
- ☐ Ayi
- ☐ Sindikudziwa

F2. Ndi chifukwa chani mukuganiza choncho?

## ZIKOMO

## APPENDIX 9: SHSA INTERVIEW GUIDE (MOBILE DISTRICTS)

### Evaluation Study of mHealth Application in iCCM Program – Malawi

#### Tool H. Key Informant Interview Guide

#### SHSA (Mobile Districts)

A	Introduction	
A1	District (circle one):	1 =Dedza   2 = Mzimba   3 = Ntcheu   4 = Ntchisi
A2	Facility name and code:	<b>Name</b> <b>Code</b> <input type="text"/> <input type="text"/>
A3	Interviewer name and code:	<b>Name</b> <b>Code</b> <input type="text"/> <input type="text"/>
A4	Date (Day / Month / Year):	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / 2016

B	Background information
---	------------------------

1. How long have you been a senior HSA?
2. How long were you an iCCM HSA before you became a senior HSA?
3. Have you received training on the HSAs' Supervisor Application for community case management? When?

C	Mobile Application Use in the iCCM Program (Mobile Districts ONLY)
---	--

(**Interviewer:** Now, I'd like us to discuss about the mobile application used by HSAs you supervise in iCCM work.)

1. When was the mobile application introduced in your facility's catchment area?
2. What was the process used to introduce the mobile application in your area?
3. How many HSAs do you directly supervise? How many of these HSAs use the mobile application?
4. Why do you think the mobile application was introduced in the iCCM program? (*Probe: what is the goal of the mobile application?*)
5. Can you describe how HSAs use the mobile application in the iCCM program? (*Probe: how do they use it during sick child assessments? Do they use it outside of sick child assessments? If yes, for what?*)
6. Do HSAs find the mobile application easy to use? On average, how long does it take HSAs to master its use?

7. Do you think HSAs like using the mobile application? Why?
8. Do the HSAs you supervise encounter any issues when using the mobile application? How often?
9. What are the most common issues HSAs encountered with using the mobile application?
10. How are the HSAs' issues with mobile application addressed? By whom?

## **D** Quality of Care in iCCM Program

*(Interviewer: Now, I'd like to ask about the quality of care that sick children receive from HSAs using the mobile application.)*

1. Can you describe what you would consider good quality of iCCM services as provided by an HSA?
2. Based on your description of good quality of iCCM services, do you think the HSAs you supervise provide good quality care to sick children in your area? Why or why not? *(Probe: Classify sick children? Treat sick children? Refer sick children?)*
3. During your supportive supervisory visits to the HSAs how do you normally assess the quality of care the HSAs provide? What do you check for?
4. What quality issues do you find when HSAs use the mobile application to assess sick children? Why?
5. Do you think the use of the mobile application has affected the quality of care that HSAs provide to sick children? Why?
6. Do you think the use of the mobile application has affected the number or type of referrals? Why?
7. Has the introduction of the mobile application changed the support that you provide to HSAs to improve the quality of care that they provide? If so, how?
8. How often are you scheduled to conduct supportive supervisory visits to each HSA? Do you adhere to that schedule? If NO, why do you miss your scheduled supervisory visits?
9. Do you think that caregivers are confident in the care their children receive when HSAs use the mobile application versus when they do not? Why?

## **E** Data Quality and Use

*(Interviewer: Now, I'd like to get your opinions about the quality of iCCM data that HSAs collect and report.)*

1. Can you describe what you would consider good data quality?
2. In your roles and responsibilities as senior HSA, what important decisions are you expected to make that are related to the iCCM work?
3. In the past year, which of these decisions have you used data to make plans for?

If yes:

- What was the source of that data?
- How easy was it to obtain and use that data?

If No, why?

4. How comfortable do you think HSAs are with using the mobile application during the sick child assessments to collect data? Why do you say so?
5. Do you think HSAs make mistakes when entering data on sick children into the mobile application? What kind of mistakes do they often make? How easy is it to catch and correct those mistakes?
6. From your experience, how easy is it for HSAs to learn how to use the mobile application to collect information on sick children? Explain?
7. What are the most frequent complaints do HSAs have regarding using the mobile application to collect data during sick children assessments? How were these complaints addressed?

*Interviewer: We know that there is a double reporting burden for HSAs who use the mobile application. They enter the data in their phones, and they also have to enter the information into their village clinic register and then fill out Form 1A at the end of every month.*

8. When HSAs assess sick children with the mobile application, do they record the information in their village clinic registers during the consultation? If not, when do they do it?
9. During supervisory visits, do you review the HSA's data both on the phone and in the village clinic register? What can you tell me about the quality of the data collected and reported by HSAs?
  - Via the mobile application
  - Via the paper based village clinic registers and Form 1A?
10. Is there information that you need or want for your work that is captured when HSAs use the mobile application that is not available in the village clinic register, or vice versa? What are these data fields?
11. Are data submitted through the mobile application by HSAs to D-tree always available to you when you need it? How do you access it? How frequently?
12. Do you encounter challenges in accessing the iCCM data from D-tree? If yes, what are they?
13. Have you used data from D-tree to monitor the work of HSAs, take action or make program decisions? Which actions or decisions?
14. Have you used data from village clinic registers and Form 1A to monitor the work of HSAs, take action or make program decisions? Which actions or decisions?

15. Are there decisions or actions that you would like to take but cannot because you don't have data to inform them? How can this be improved?

<b>F</b>	<b>Recommendations</b>
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1. What are the challenges you encounter when using the mobile application in terms of:
  - Supervising HSAs?
  - Using iCCM data?
2. What are the challenges do you see HSAs encounter when using the mobile application in terms of providing care or collecting and submitting data?
3. Would you recommend taking this technology to scale nation-wide as a:
  - Decision support tool? Why?
  - Data collection and reporting tool? Why?
4. If yes, based on your experience, what are important factors to consider?

### **Closing**

That covers the things I wanted to ask. Is there anything you would like to add?



## APPENDIX 10: SHSA INTERVIEW GUIDE (NON-MOBILE DISTRICTS)

### A Evaluation Study of mHealth Application in iCCM Program – Malawi

#### Tool I. Key Informant Interview Guide

##### SHSA (Non Mobile Facilities)

A	Introduction	
A1	District (circle one):	1 =Dedza 2 = Mzimba 3 = Ntcheu 4 = Ntchisi 5 = Lilongwe 6 = Nkhatabay 7 = Rumphi
A2	Facility name and code:	Name Code <input type="text"/> <input type="text"/>
A3	Interviewer name and code:	Name Code <input type="text"/> <input type="text"/>
A4	Date (Day / Month / Year):	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / 2016

B	Background information
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1. How long have you been a senior HSA?
2. How long were you an iCCM HSA before you became a senior HSA?
3. Have you received training on HSA supervision for community case management? When?
4. How many HSAs do you directly supervise?

C	Use of data collection and reporting forms in the iCCM Program
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(**Interviewer:** Now, I'd like to get your opinions about HSAs' use of village clinic registers and Form 1A in iCCM work.)

1. How many of the HSAs who you supervise have been trained on how to use iCCM data collection and reporting forms (the village clinic register and monthly reporting form, Form 1A) ?
2. On average, how long does it take HSAs to master and become comfortable with using the village clinic register and Form 1A? Please explain?
3. Can you describe how HSAs use their sick child reporting form and village clinic registers? (*Probe: how do they use them during sick child assessments, do they refer to them for guidance?*)
4. How easy do you think it is for HSAs to use the sick child reporting form, village clinic register and Form 1A in their iCCM work? Please explain?
5. What are the most common issues do the HSAs you supervise encounter when using the village clinic register or Form 1A? How often do they encounter these issues?

6. How are the issues encountered by HSAs with using the village clinic register or Form 1A addressed? By whom?

## **D** Quality of Care in the iCCM Program

*(Interviewer: Now, I'd like to get your views on the quality of care that sick children receive from HSAs)*

1. Can you describe what you would consider good quality of iCCM services as provided by an HSA?
2. Based on your description of good quality iCCM services, do you think the HSAs you supervise provide good quality care to sick children? Why or why not? (Probe: Classify sick children? Treat sick children? Refer sick children?)
3. What form, job aid, or tool do the HSAs follow to guide them during their assessments of sick children? Probe: *If not mentioned ask:*
  - Do the HSAs you supervise use the Sick Child Reporting Form to guide them in their assessments of sick children? Why or why not?
4. Do you think it is easy for the HSAs to use the Sick Child Form to guide the assessments of sick children? Please explain why or why not?
5. Do you think HSAs make mistakes in their assessments, classifications, treatment, or referrals of sick children? Please explain why or why not?
6. What are the common issues related to the quality of iCCM services that HSAs provide that you can tell me about?
7. During your supportive supervisory visits to the HSAs how do you normally assess the quality of care the HSAs provide? What do you check for?
8. How often are you scheduled to conduct supportive supervisory visits to each HSA? Do you adhere to that schedule? If NO, why do you miss your scheduled supervisory visits?
9. Do you think that caregivers are confident in the care their children receive from HSAs? Why?

## **E** Data Quality and Use

*(Interviewer: Now, I'd like to get your opinions about the quality of iCCM data that HSAs collect and report.)*

1. Can you describe what you would consider good data quality?
2. In your roles and responsibilities as senior HSA, what important decisions are you expected to make that are related to the iCCM work?
3. In the past year, which of these decisions have you made regarding the iCCM program work using data to plan for them? (Probe: decisions related to HSAs' performance, training, and other tasks performed at facility level).  
If have used data:

- What was the source of that data?
- How easy was it to obtain and use that data?

If have not used data, why?

4. How easy do you think it is for HSAs to complete the village clinic registers during the sick child assessments and aggregate data monthly to Form 1A? Why do you say so?
5. Do you think HSAs make mistakes when recording information on sick children into the village clinic registers and then Form 1A? If yes, what kinds of mistakes do they often make? How easy is it for you as a SHSA to catch and correct those mistakes?
6. What are the most frequent complaints HSAs have regarding using the village clinic register for sick children assessments and collecting data at the same time? How have these complaints been addressed?
7. During supervisory visits, do you review the HSA's data in the village clinic register?
8. Overall, what can you tell me about the quality of the data collected and reported by HSAs via the village clinic registers and Form 1A?
9. Have you used data from village clinic registers and Form 1A to monitor the work of HSAs, take action or make program decisions? Which actions or decisions?
10. Are there decisions or actions that you would like to take but cannot because you don't have data to inform them? How can this be improved?

<b>F</b>	<b>Recommendations</b>
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1. What would you recommend should be done to help improve the quality of the iCCM services that HSAs provide?
2. What would you recommend should be done to help improve data quality for the iCCM program?

### **Closing**

That covers the things I wanted to ask. Is there anything you would like to add?

## APPENDIX 11: DISTRICT LEVEL INTERVIEW GUIDE (MOBILE DISTRICTS)

### Evaluation Study of mHealth Application in iCCM Program – Malawi

#### Tool J. Key Informant Interview Guide

##### District Level (with Mobile Districts)

August 26, 2016

<b>A</b>	<b>Introduction</b>	
A1	District (circle one):	1 =Dedza 2 = Mzimba 3 = Ntcheu 4 = Ntchisi 5 = Lilongwe 6 = Nkhatabay 7 = Rumphi
A2	Role/Job Title of Interviewee:	
A3	Interviewer name and code:	
A4	Date (Day / Month / Year):	□□ / □□ / 2016

<b>B</b>	<b>Background information</b>
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1. How long have you been in your current position?
2. What are your major responsibilities in this position?
3. Have you received training on HSAs' Supervisor Application for community case management? If yes, when?

<b>C</b>	<b>Mobile Application Use in the iCCM Program (Mobile Districts ONLY)</b>
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*(Interviewer: I'd like to get your opinions about the implementation of the mobile application used by HSAs in for the iCCM work in your district.)*

1. When was the mobile application introduced in your district?
2. What was the process used to introduce the mobile application in your district? (Probe: Before HSAs started using the mobile app, were communities made aware that HSAs would be using phones during sick child assessments?)
3. Why do you think the mobile application was introduced in the iCCM program? (Probe: What is the goal of introducing the mobile application?)
4. How many HSAs in your district currently use the mobile application? How long have they been using the mobile application in their iCCM work?
5. Can you describe how HSAs use the mobile application in the iCCM program? (Probe: How do they use it during sick child assessments? Do they use it outside of child assessments? If yes, for what?)

6. Do HSAs find the mobile application easy to use? On average, how long does it take HSAs to master its use?
7. Do you think HSAs like using the mobile application? Why?
8. What issues are you aware of that HSAs encounter when using the mobile application? How often?
9. What issues are you aware of that senior HSAs encounter when using the mobile application themselves or providing support to HSAs? How often?
10. How are the issues encountered when using the mobile application addressed?
11. Has the HSAs' use of mobile application affected the iCCM program within the district? If so, how?  
(Probe: reporting, training)

## **D** Quality of Care in iCCM Program

(Interviewer: I'd like to get your opinions about the quality of care that sick children receive from HSAs.)

1. Can you describe what you would consider good quality of care as provided by an HSA?
2. Based on your description of good quality of care, do you think the HSAs you supervise provide good quality care to sick children in your area? Why or why not? (Probe: Classify sick children? Treat sick children? Refer sick children?)
3. Do you think the use of the mobile application has affected the quality of care that HSAs provide to sick children? How?
4. Do you think the use of the mobile application has affected the number or type of referrals? Why?
5. What support do you provide to senior HSAs to improve their iCCM work? Has the introduction of the mobile application changed that support? If so, how?
6. How often do you conduct supervisory visits of village clinics? In your last village clinic visit, what did you do? Is there anything that you wanted to do but could not do? (for example, you ran out of time)
7. Is there anything that you do to specifically support use of the mobile application? (Probe: When/how do you provide this support?)
8. Do you think that caregivers are confident in the care their children receive when HSAs use the mobile application versus when they do not? Why?

## **E** Data Quality and Use

(Interviewer: Now, I'd like to get your opinions about the quality of iCCM data that HSAs collect, report, and use.)

1. Can you describe what you would consider good data quality?

2. In your work as a (District IMCI or RAcE Coordinator), what kind of programmatic decisions are you expected to make related to the iCCM work? (Probe: decisions that are within your control when doing your job related to iCCM program)

3. In the past year, which of these programmatic decisions have you made using data or other evidence?

If yes:

○ What was the source of that data?

- ☐ DHIS 2
- ☐ D-tree database/dashboard
- ☐ cStock
- ☐ iCCM paper reporting forms (Forms 1A/1B)
- ☐ Program report
- ☐ Other, specify \_\_\_\_\_

○ How easy was it to obtain these data? (*Interviewer: Find out for each data source.*)

If No to use of data, why?

4. Are data submitted through the mobile application by HSAs to D-tree always available to you when you need it? How do you access it? How frequently?

5. Which iCCM data sources are available to you if you wanted to use them? Explain why you think so?

6. Do you encounter challenges in accessing the iCCM data from D-tree? If yes, what are they?

7. What can you tell me about the quality of the data collected and reported by HSAs?

○ Via the mobile application

○ Via the paper based village clinic registers, Form 1A, and Form 1B?

8. Is there information that you need or want for your work that is captured when HSAs use the mobile application that is not available in the village clinic register, or vice versa? What are these data fields?

9. Have you used data from D-tree to monitor the iCCM work in the district, take action or make program decisions? Which actions or decisions have you made? If not, why?

10. Have you used data from the DHIS 2 to monitor the iCCM work in the district, take action or make program decisions? How have you used data? In which actions or decisions?

11. Are iCCM data included DHIS 2 always available to you when you need it? How frequently do you use it?

12. Are there decisions or actions that you would like to take but cannot because you don't have data to inform them? How can this be improved?

<b>F</b>	<b>Recommendations</b>
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(**Interviewer:** Now, I'd like to get your views based on what you have learned about using the iCCM mobile application for improving quality of care and data quality.)

5. Overall what are the most important successes of implementing the mobile application in your district?
6. Overall what are the major challenges of implementing the mobile application in your district?
7. Would you recommend taking this technology to scale nationwide as a:
  - Decision support tool? Why?
  - Data collection and reporting tool? Why?
8. If yes, based on your experience, what are important points to consider?

### **Closing**

That covers the things I wanted to ask. Is there anything you would like to add?

## APPENDIX 12: DISTRICT LEVEL INTERVIEW GUIDE (NON-MOBILE DISTRICTS)

### Evaluation Study of mHealth Application in iCCM Program – Malawi

#### Tool K. Key Informant Interview Guide District Level (**No Mobile Districts**)

<b>A</b>	<b>Introduction</b>	
A1	District (circle one):	1 =Dedza   2 = Mzimba   3 = Ntcheu   4 = Ntchisi 5 = Lilongwe 6 = Nkhatabay 7 = Rumphi
A2	Role/Job Title of Interviewee:	
A3	Interviewer name and code:	
A4	Date (Day / Month / Year):	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / 2016

<b>B</b>	<b>Background information</b>
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1. How long have you been in your current position?
2. What are your major responsibilities related to the iCCM program in this position?

<b>C</b>	<b>Use of data collection and reporting forms in the iCCM Program</b>
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(**Interviewer:** Now, I'd like to get your opinions about the HSAs' use of village clinic registers and Form 1A in iCCM work.)

1. How many HSAs have been trained on how to use iCCM data collection and reporting forms (the village clinic register and monthly reporting form, Form 1A) in your district?
2. On average, how long does it take the HSAs to master and become comfortable with using the village clinic register and Form 1A? Please explain why?
3. Can you describe how HSAs use their sick child reporting form and village clinic registers? (*Probe: how do they use them during sick child assessments, do they refer to them for guidance?*)
4. How easy do you think it is for the HSAs to use the sick child reporting form, village clinic register and Form 1A in their iCCM work? Please explain?
5. Do you conduct supervisory visits to the SHSAs and HSAs? How often?
6. What are the most common issues HSAs and SHSAs encounter when using the village clinic registers, Form 1A or Form 1B? What and how often?



7. How are HSAs' and SHSAs' challenges with using the village clinic registers, Form 1A or Form 1B in iCCM work addressed? By whom?
8. Have you been trained on D-tree mobile application? If, yes – what do you or others think about it?
9. Do you think it should be something that the HSAs in your district should be trained on and use? Why or why not?

<b>D</b>	<b>Quality of Care in iCCM Program</b>
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*(Interviewer: I'd like to get your opinions about the quality of care that sick children receive from HSAs.)*

10. Can you describe what you would consider good quality of care as provided by an HSA?
11. Based on your description of good quality of care, do you think the HSAs you supervise provide good quality care to sick children in your area? Why or why not? (Probe: Classify sick children? Treat sick children? Refer sick children?)
12. What form, job aid, or tool do the HSAs follow to guide them during the assessments of sick children? Probe: *If not mentioned ask:*
  - Do the HSAs use the Sick Child Reporting Form to guide them in the assessments of sick children? Why or why not?
13. Do you think it is easy for the HSAs to use sick child form to guide the assessments of sick children? Please explain?
14. What are the common mistakes related to the quality of iCCM services that HSAs make when providing care in the assessment, classifications, treatment, or referrals of sick children that you can tell me about?
15. During your supportive supervisory visits to the SHSAs how do you normally assess the quality of care the HSAs who report to each of them provide? What do you check for?
16. How often do conduct supervisory visits of village clinics? In your last village clinic visit, what did you do? Is there anything that you wanted to do but could not do? (for example, you ran out of time)
17. Do you think that caregivers are confident in the care their children receive from HSAs? Why?

<b>E</b>	<b>Data Quality and Use</b>
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*(Interviewer: Now, I'd like to get your opinions about the quality of iCCM data that HSAs collect, report, and use.)*

1. Can you describe what you would consider good data quality?
2. In your work as a (District IMCI or RAcE Coordinator), what kind of programmatic decisions do you make? (Probe: decisions that are within your control when doing your job related to iCCM program)
3. Which of these programmatic decisions have you made in the past year using data or other evidence?

For each decision you made with data:

- What was the source of that data?
  - ☐ DHIS 2
  - ☐ cStock
  - ☐ iCCM paper reporting forms (Forms 1A/1B)
  - ☐ Program report
  - ☐ Other, specify \_\_\_\_\_
- How easy was it to obtain these data? *(Interviewer: Find out for each data source.)*

If you didn't use data, why?

4. Are data from this sources available and accessible to you when you need it? (Timeliness of data). Please, explain why or why not?
5. How easy do you think it is for HSAs to complete the village clinic registers during the sick child assessments? Why do you say so?
6. Do you think HSAs make mistakes when entering data on sick children into the VHC registers? What kind of mistakes do they often make? How easy is it to catch and correct those mistakes?
7. What are the most frequent complaints do HSAs have regarding using the VHC registers for sick children assessments and collecting data at the same time? How have these complaints addressed?
8. What can you tell me about the quality of the data collected and reported by HSAs and SHSAs?
  - Via the village clinic registers, Form 1A, and Form 1B?
9. Have you used data from the DHIS 2 to monitor the iCCM work in your district, take action or make program decisions? How have you used data? In which actions or decisions?
10. Are iCCM data included in DHIS 2 always available to you when you need them? How frequently do you use them?

11. Are there decisions or actions that you would like to take but cannot because you don't have data to inform them? How can this be improved?

<b>F</b>	<b>Recommendations</b>
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*(Interviewer: Now, I'd like to get your views based on what you have learned about using village clinic registers and Forms 1A to guide sick child assessments and to collect quality data.)*

1. Overall what are the most important success factors that have contributed to good quality of iCCM services and good quality of data in your district?
2. Overall what are the major challenges of implementing the village clinic registers, Form 1A and Form 1B in your district?
3. What would you recommend to improve the quality of iCCM services and iCCM data quality? Please, explain?

### **Closing**

That covers the things I wanted to ask. Is there anything you would like to add?

## APPENDIX 13: D-TREE STAFF INTERVIEW GUIDE

### Evaluation Study of mHealth Application in iCCM Program – Malawi

#### Tool L. Key Informant Interview Guide

##### D-tree Level (2 staff)

<b>A</b>	<b>Introduction</b>	
A1	D-tree Level	
A2	Role/Job Title of Interviewee:	
A3	Interviewer name and code:	
A4	Date (Day / Month / Year):	<input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / 2016
<b>B</b>	<b>Respondent Background information</b>	

1. How long have you worked on the mobile application for the iCCM program?
2. What are your major responsibilities related to the iCCM mobile application?

<b>C</b>	<b>Mobile Application Development, Rollout and Implementation</b>
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(**Interviewer:** I'd like to ask you about the development, rollout and implementation of the iCCM program mobile application.)

##### Past/Present

1. Why was the application introduced? What were the objectives?
2. How was the application introduced? (Probe: Describe the process that was used to rollout the application.)
3. Who are the key players (collaborators) in the development, initial rollout, and implementation support of the mobile application? And what roles do they have? (Probe: Which organizations, institutions, government departments, donors?)
  - Development:
  - Initial rollout:
  - Implementation support:
4. [Ask only if don't yet have answer] What is D-tree's role in the implementation of the mobile application? (Probe: What did you do or are you doing related to application introduction, training, usage, and ongoing supervision, and improvement of the application?)
5. [Ask only if don't yet have answer] Describe how D-tree has supported scale-up or rollout in of the mobile application to different districts?

6. In the development and adaptation of the mobile application and dashboard, how were end users involved? And at what stages were they involved? (Probe: Were users (HSAs, senior HSAs, and district staff) consulted?)
7. What modifications have you made to the initial version of the mobile application? Why were these modifications made?
8. How often does D-tree update the mobile application? Why? (Probe: Tailoring the SHSA supervision protocol, policy changes, how easy has it been to update the application?)
9. Is the application open-source?

### Future

10. How easy or challenging would it be to modify the mobile application to include additional child health components beyond iCCM, such as maternal and newborn care?
11. What additional functionality or features do you plan to add to the mobile application?
12. Is cStock integrated with the mobile application? (Probe: What is the status of integration? Where has it been rolled out? All HSAs?)
13. How feasible is it to integrate D-tree dashboard with DHIS 2 and cStock?
14. What is the long-term plan for maintenance and support of the application?
15. Is there someone in the MOH IMCI unit who has been trained (beyond orientation)? Can D-tree hand over their responsibilities to the government?

## D Mobile Application Technical Support to Users

*(Interviewer: Now I'd like to ask you about the technical support that D-tree provides to users of the mobile application.)*

1. How many people at D-tree are directly providing support to the mobile application usage? What percentage of their time is used?
2. How is technical support provided to the HSAs using the mobile application in the field?
  - ☐ Call-in to the helpdesk? Describe
  - ☐ Peer support group application? Describe
  - ☐ Super users? Describe
  - ☐ Other? Describe
3. How long does it take a new HSA to learn to independently use the mobile application in their work?
4. What are the common challenges that HSAs encounter when using the mobile application? How have these challenges been addressed? Which issues remain?

5. What technical support do you provide to people other than HSAs, such as MOH or DHO staff?

<b>E</b>	<b>Mobile Application Quality of Care</b>
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(Interviewer: Now, I'd like to ask your views about the quality of care that sick children receive from HSAs using mobile application)

1. Can you describe what you would consider good quality of care as provided by an HSA?
2. Can you describe the standard process of how HSAs use the mobile application to assess sick children and to record the classification, referral, and treatment information? Do the HSAs always adhere to that process? Why or why not?
3. How does the application ensure that good quality of care standards are maintained during use by HSAs?
4. Do you think the use of the mobile application has affected—either positively or negatively—the quality of care that HSAs provide to sick children compared to the use of the paper-based guidelines? How? (Probe: assessment, classification, referral, treatment)
5. In your opinion, has the objective of using mobile application related to supporting quality of care been achieved? Explain why or why not.
6. What have HSAs identified as the common challenges in providing good quality of care to sick children when using the mobile application? How can these issues be addressed?

<b>F</b>	<b>Mobile Application Data Quality and Use</b>
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(Interviewer: Now, I'd like to get your opinions about the quality of data that HSAs collect and report on iCCM through the mobile application)

1. Can you describe what you would consider good data quality?
2. Do you have an established plan to check for quality of iCCM data submitted by HSAs to D-tree? What do you check for? How often?
3. What are the common data quality issues and errors that you have identified with the iCCM data submitted by HSAs through the mobile application to D-tree database?
4. Does D-tree have a process for systematically addressing data quality issues with HSAs? Please explain?
5. Does D-tree discuss any of the data quality issues with the MoH IMCI, district, or SHSAs? Explain
6. In your opinion, how does HSAs' use of the mobile application affect—positively or negatively—the quality of iCCM data?
7. Does D-tree run weekly or monthly reports based on the data in the database? Why or why not? Who are these reports shared with?

8. Who has access to the D-tree dashboard? How often do they access the dashboard?
9. Does D-tree facilitate training of iCCM staff on how to access and use the D-tree data for decision making? Please explain?
10. In your opinion, are D-tree data accessed and used for program decision making? Do you monitor the use of the datasets? Please provide some examples of the users and program decisions where they have used D-tree database as a source?
11. What are the common issues that users have when trying to access the D-tree dashboard?
12. What are the common issues HSAs encounter with the mobile application when recording data during a sick child assessment and in submitting data to D-tree?

<b>G</b>	<b>Mobile Application Recommendations</b>
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*(Interviewer: Now, I'd like to get your views based on what you have learned about using the iCCM mobile application for improving quality of care and data quality.)*

1. Overall what have been the most important successes of implementing the mobile application in the iCCM program?
2. Overall what have been the major challenges of implementing the mobile application in the iCCM program?
3. Would you recommend taking this technology to scale nationwide as a:
  - Decision support tool? Why?
  - Data collection and reporting tool? Why?
4. If yes, based on your experience, what are important factors to consider?

### **Closing**

That covers the things I wanted to ask. Is there anything you would like to add?

## APPENDIX 14: CENTRAL-LEVEL STAFF INTERVIEW GUIDE

### Evaluation Study of mHealth Application in iCCM Program – Malawi

#### Tool M. Key Informant Interview Guide

#### Central Level

(Ministry of Health IMCI Unit and Save the Children)

<b>A</b>	<b>Introduction</b>	
A1	Central Level	1. Ministry of Health, IMCI Unit; 2. Save the Children
A2	Role/Job Title of Interviewee:	
A3	Interviewer name and code:	
A4	Date (Day / Month / Year):	□□ / □□ / 2016
<b>B</b>	<b>Background information</b>	

1. How long have you been in your current position?
2. What are your major responsibilities in this position as they relate to the iCCM program?

<b>C</b>	<b>Mobile Application Use in the iCCM Program</b>
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(**Interviewer:** I'd like to ask you about the D-tree mobile application development and implementation for iCCM program in Malawi).

1. When was the mobile application introduced in the iCCM program in Malawi?
2. Why was the mobile application introduced? What were the objectives?
3. Is there a national strategy or policy that supports the establishment and implementation of this mobile application for the iCCM program? If yes, is there also a national implementation plan?
4. How was the mobile application introduced? (*Probe: Describe the process that was used to rollout the application.*)
5. Who are the key players (collaborators) in the development and implementation of the mobile application? And what roles do they have? (*Probe: which organizations, institutions, government departments, donors.*)
6. In the development and adaptation of the mobile application and dashboard for iCCM program, how was it determined as to what to include? Who was involved and how? (*Probe: Were users (HSAs) consulted? How and at what stages?*)
7. What was or is your organization's (or Ministry's) role in the implementation of mobile application? (*Probe: what did you do or are doing in each stage of implementation such as introduction, training, usage, and ongoing supervision, and improvement of the application?*)



8. Can you describe what support D-tree provides to HSAs and other users of the mobile application for the iCCM program? *(Probe: What does D-tree staff do in training, usage, ongoing supervision, and improvement of the mobile application?)*
9. How are HSAs selected for the mobile application training?
10. What does it take and how long does it take a new HSA to learn and master the use of the mobile application effectively in their work? How does that differ with mastering how to use the paper-based tools?
11. What are the common characteristics of HSAs who become super users?
12. What are the common challenges that HSAs encounter in using the mobile application? How have these challenges been addressed? Which issues remain?
13. Does the MOH have the capacity to take over support and management of the mobile application and database that D-tree is currently providing?
14. Are you currently thinking about integrating the mobile application data with DHIS 2? What about with cStock? Can you describe the plan?

<b>D</b>	<b>Quality of Care in the iCCM Program</b>
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*(Interviewer: Now, I'd like to ask your views about the quality of care that sick children receive from HSAs using mobile application)*

1. Can you describe what you would consider good quality of care as provided by an HSA?
2. Do you have defined quality of care standards for the iCCM program? Are they documented *(Probe: ask for the document)?*
3. Based on your description of good quality of care, how do you engage iCCM program staff including district officers, SHSAs, and HSAs to improve the quality of iCCM services? *(Probe: what is done?)*
4. Do you think the use of the mobile application has affected the quality of care that HSAs provide to sick children compared to the use of the paper-based guidelines? How? *(Probe: assessment, classification, referral, treatment)*
5. In your opinion, has the objective of using mobile application related to supporting quality of care been achieved? Explain why or why not.
6. What are the common issues related to the quality of care provided by HSAs using the mobile application? How can these issues be addressed?

<b>E</b>	<b>Data Quality and Use</b>
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(*Interviewer:* Now, I'd like to get your opinions about the quality of iCCM data that HSAs collect and report)

1. Can you describe what you would consider good data quality?
2. In your work as a [Job title], what kind of programmatic decisions do you make related to iCCM program implementation?
3. Which of these programmatic decisions have you made in the past year using data or other evidence?

If yes:

- What was the source of the data you used?
  - ☐ DHIS 2
  - ☐ D-tree database/dashboard
  - ☐ cStock
  - ☐ iCCM paper reporting forms (Forms 1A/1B)
  - ☐ Program report
  - ☐ Other, specify \_\_\_\_\_
- How easy was it to obtain these data? (*Interviewer: Find out for each data source.*)

If No, why?

4. Which iCCM data sources do you think are easy to access? Describe who and how they can access and analyze the data?
5. Are data submitted through mobile application by HSAs to D-tree always available to you when you need it? How about the data submitted through paper based system to the DHIS? What is the frequency for each?
6. Do you encounter challenges in accessing the iCCM data from D-tree? If yes, what are they?
7. What are the challenges you see HSAs encounter when using the mobile application in terms to collect and submit data? How have these challenges been addressed? Which issues remain?
8. What can you tell me about the quality of the data collected and reported by HSAs?
  - Via the mobile application?
  - Via the paper based system and DHIS 2?
9. Do you have an established plan to monitor data quality? Is it different for districts that are using the mobile application versus those that are using paper-based forms?
10. Is there information that you need or want for your work that is captured when HSAs use the mobile application that is not available in the village clinic register, or vice versa? What are these data fields?

11. Does D-tree run weekly or monthly reports based on the data in their dashboard? Are these reports shared with you and other iCCM program staff? With whom? Why or why not?
12. Have you used data from D-tree to monitor the work of HSAs, take action or make program decisions? How and which actions or decisions?
13. Have you used data from DHIS 2 to monitor iCCM program activities or to make any program decision? How have you used the DHIS 2 data? Name actions or decisions.
14. Are there decisions or actions that you would like to take but cannot because you don't have data to guide them? How can this be improved?
15. Has your organization/MOH office facilitated training of district and facility staff to use data for decision making? What data are used? How effective do you think the trainings are in promoting data use? *(Probe: Do you see that district and facility staff are using data? Can you give an example?)*
16. How do you support the use of data at the community level? *(Probe: HSAs, SHSAs, district staff)*

## F

## Recommendations

*(Interviewer: Now, I'd like to get your views based on what you have learned about using the iCCM mobile application for improving quality of care and data quality.)*

1. Overall what are the most important success factors of implementing the mobile application for iCCM program?
2. Overall what are the major challenges of implementing the mobile application for iCCM program?
3. Would you recommend taking this technology to scale nationwide as a:
  - a. Decision support tool? Why?
  - b. Data collection and reporting tool? Why?
4. If yes, based on your experience, what are important points to consider?

## Closing

That covers the things I wanted to ask. Is there anything you would like to add?