

Taking Stock of M&E Lessons: Successes, Challenges, and Innovations

Indoor Residual Spraying (IRS 2) Task Order 1



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Table of Contents

	Page
List of Figures.....	iii
List of Tables	iii
Acronyms	iv
1. Introduction	1
1.1 Objective of this assessment	1
1.2 Background.....	1
1.3 Definitions	2
1.4 Elements of an M&E system.....	2
2. Overview of IRS Monitoring and Evaluation Activities	3
2.1 Background (IVM 1 and IRS 1)	3
2.1.1 Early M&E constraints	3
2.1.2 Actions taken to overcome challenges	4
3. Implementing a Standardized M&E System and Piloting Innovative Approaches.....	5
3.1 Enhancements made to the M&E system	5
3.1.1 Development of a comprehensive M&E plan for IRS.....	5
3.1.2 Implementation of SOPs and harmonization of indicator definitions	5
3.1.3 Enhance M&E capacity to collect, organize, and report IRS data	6
3.1.4 Improving performance monitoring and reporting	7
3.2 Piloting innovative practices.....	7
3.2.1 Improving structure count through use of an IRS card for household identification	7
3.2.2 Implementing an electronic IRS information management system (IRS relational database).....	9
3.2.3 Piloting the pre-entry of IRS structure information (Mali, Benin, Rwanda, Mozambique).....	11
3.2.4 Piloting cellphone-based short message service technology for IRS (Ghana and Ethiopia)	13
3.2.5 Geographical Information System (GIS) for data collection.....	17
3.3 Summary of lessons learned	19
Annex A: Key Informants Analysis Tool	23
Annex B: IRS Results Framework.....	24
Annex C: IRS Indicator Matrix.....	25

List of Figures

	Page
Figure 1: Sample of IRS Structure Card (Front)	7
Figure 2: Sample of IRS Structure Card (Back).....	8
Figure 3: Sample Mali Structure Code.....	8
Figure 4: Home Screen of the IRS SMS Database	13
Figure 5: A Sample View for Creating a New User.....	14

List of Tables

	Page
Table 1: Mechanisms to Strengthen M&E for IRS 2 Task Order 1, 2011	4

Acronyms

ACT	artemisinin-based combination therapy
DHS	Demographic and Health Survey
DQA	data quality assessment/audit
GIS	geographical information system
GPS	global positioning system
HIN	house identification number
HMIS	health management information system
IEC	information, education, and communication
IPTp	intermittent preventive treatment for pregnant women
IRS	indoor residual spraying
IT	information technology
ITN	insecticide-treated net
IVM	integrated vector management
M&E	monitoring and evaluation
MICS	malaria indicator cluster survey
MIS	management information system
MOH	Ministry of Health
NMCP	National Malaria Control Program
PC	personal computer
PDA	personal digital assistant
PM	project manager
PMI	US President's Malaria Initiative
SMS	short message service (cell phone text message)
SOP	standard operating procedure
SPR	spray performance report
USAID	United States Agency for International Development
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme

1. Introduction

1.1 Objective of this assessment

This report discusses lessons learned in monitoring, analyzing, and reporting on malaria control operations using the indoor residual spraying (IRS) of households with insecticide. Special emphasis is placed on identifying innovations that came from IRS country programs supported through the U.S. President's Malaria Initiative (PMI),¹ operational challenges and successes, opportunities, and gaps and recommending actions needed to strengthen monitoring and evaluation (M&E) at the country level.

For this review, a short, open-ended, semi-structured questionnaire (*Annex A*) was presented to country chiefs of party and M&E staff to get their input. IRS country staff in Benin, Burkina Faso, Madagascar, Mali, Mozambique, Senegal, and Kenya participated in the survey. Country team views and observations were supplemented by document reviews of country quarterly, semi-annual, and end-of-spray reports (i.e., spray performance reports [SPRs]) and from deliberations of a program planning workshop held in late 2010.

1.2 Background

In July 2005, the U.S. Government launched a five-year, \$1.2 billion malaria initiative to rapidly scale up malaria prevention and control interventions in 15 high-burden countries in sub-Saharan Africa. With passage of the 2008 Lantos-Hyde Act, funding for PMI was extended through fiscal year 2014, and the initiative expanded to a total of 19 countries. The goal of PMI is to cut malaria-related mortality by half by covering 85% of vulnerable populations with artemisinin-based combination therapies (ACTs), insecticide-treated nets (ITNs), and intermittent preventive treatment for pregnant women (IPTp). In some targeted areas, these approaches are complemented by IRS.

For IRS operations, the objective is to achieve IRS coverage of at least 85% in target communities, with a safe and highly effective application of insecticide inside homes. Working in partnership with National Malaria Control Programs (NMCPs) and in support of country-level malaria strategic plans, PMI provides technical, managerial, and commodity support for IRS operations in all PMI countries.

To ensure successful delivery of IRS and to promote sustainability, IRS is implemented within existing national policy frameworks and country priorities. The majority of PMI focus countries have decentralized health systems that reach from the national level down to regional, district, and community levels. The NMCPs are the lead partner agencies, and RTI's mandate is to build capacity within the NMCPs and other partners to plan and implement safe and effective IRS operations in PMI focus countries. In a fully operational IRS program, each RTI IRS team works with the NMCP and PMI to establish country-specific IRS objectives and targets in its annual

¹ <http://www.pmi.gov>

work plans. The IRS teams—in coordination with the NMCPs and district health teams in each country—are accountable for effective performance and therefore are responsible for monitoring how IRS resources are being used.

1.3 Definitions

For the purpose of this document, **monitoring** is a systematic and continuous assessment of the project performance over a given period of time. The planning elements of monitoring frameworks are closely linked with work planning, and the two should be developed together. Ongoing monitoring to support management requires that the data collected respond to management requirements to support decision-making. **Project monitoring** therefore provides feedback on whether implementation of the IRS project is proceeding as originally planned. **Evaluation** is intended to determine whether a program had the desired effects on individuals, households, communities, and institutions and whether those effects are attributable to the program intervention. **Process monitoring and evaluation** examines whether and how project activities achieve their intended results.

The **IRS results framework** (*Annex B*) forms the basis for monitoring and reporting. It focuses on assessing progress of the implementation of IRS operations and achievement of vector control outcomes and of reduction in malaria transmission. It is based on a series of verifiable indicators. Each indicator isolates one aspect of the result and is designed to provide useful information for program managers to inform implementation and resource allocation decisions (see *Annex C*). These indicators form the basis on which the IRS program's M&E system is built.

1.4 Elements of an M&E system

M&E provides the information required for effective project management and for reporting and accountability. Developing a comprehensive program M&E system involves distinct elements:²

- a. Setting priorities and managing time
- b. Establishing baselines for targets from which progress can be measured
- c. Developing indicators (which serve both to define/interpret the objectives as well as to measure progress)
- d. Identifying project monitoring information sources, systems, and frequency of data collection (A monitoring system enables continuous feedback on the status of the IRS program, identifying specific problems as they arise.)
- e. Establishing responsibility for data collection and oversight of the monitoring process
- f. Managing information analysis and reporting, analyzing how the program operates and whether the program is on track (i.e., looking at program targets and comparing them to the actual program performance)

² List adapted from *BCPR Monitoring & Evaluation System: 2008–2011*.
<http://www.scribd.com/doc/87424041/UNDP-M-E-2008-2011>

- g. Establishing regular feedback mechanisms on lessons learned/better practices, and updating interventions in response to this feedback
- h. Noting underlying assumptions and potential risks that highlight potential obstacles to achieving the desired objectives

2. Overview of IRS Monitoring and Evaluation Activities

2.1 Background (IVM 1 and IRS 1)

RTI began supporting PMI efforts in IRS in 2006, under the Integrated Vector Management (IVM) 1 project. During the IVM 1 project, IRS operations were conducted in three countries—Angola, Tanzania, and Uganda.

From 2007 onward, RTI implemented IRS operations under the IRS 1 project in the following countries:

- In 2007, Angola, Tanzania, Uganda, Rwanda, Senegal, Malawi, and Mozambique
- In 2008, Angola, Tanzania, Uganda, Rwanda, Senegal, Malawi, Mozambique, Benin, Ghana, Mali, Kenya, Liberia, Madagascar, Zambia, and Ethiopia
- In 2009, Angola, Tanzania, Rwanda, Senegal, Mozambique, Benin, Ghana, Mali, Kenya, Liberia, Madagascar, Zambia, and Ethiopia³

2.1.1 Early M&E constraints

A 2010 needs assessment for M&E showed that although the architecture of RTI's first phase of IRS M&E was in place, operationalizing of M&E elements was sometimes weak. The M&E functions were hampered by several conceptual and methodological constraints and challenges. The following were the most common issues:

- Work plans lacked a clear M&E plan and strategy.
- There was a lack of early and thorough planning.
- Data quality was inconsistent across countries.
- Multiple data tools were in place, but these were not standardized.
- Difficulties arose in establishing a clear, consistent definition of the term “structure”; contextualization and interpretation of this term was a problem in many countries.
- There was a lack of understanding of quality assurance principles and processes, including M&E.

³ In 2009, the number of countries was reduced to 13 because operations in Uganda and Malawi were rebid as bilateral USAID awards.

- M&E capacity was limited (skills deficit), dedicated resources for M&E were lacking, and, where M&E staff existed, there was a lack of capacity to set up proper M&E systems.
- The quality of IRS data was sometimes poor (i.e., accuracy, validity, reliability, timeliness, integrity).
- The data system was unable to quickly determine which houses had been sprayed, especially when “mop-up” operations had to be conducted.
- Early monitoring did not always track which spray operators sprayed which structures/villages.
- Data collected on information, education, and communication (IEC) were not always used or not used fully.
- Monitoring the performance of IEC teams proved a challenge, with little process evaluation or quality assurance and quality improvement.
- Field supervision did not necessarily include periodic checks on data collection.
- Initially, conducting data quality assessments (DQA) was not a mandatory requirement for M&E systems, or there was lack of enforcement.

2.1.2 Actions taken to overcome challenges

In response to component 5 of the IRS 2 Task Order 1, and to address operational challenges, RTI instituted several mechanisms in 2010–2011 to strengthen its M&E component (Table 1).

Table 1: Mechanisms to Strengthen M&E for IRS 2 Task Order 1, 2011

Challenges in IRS 1	Responses in IRS 2
<ul style="list-style-type: none"> • No single, authoritative written M&E plan 	Develop a framework for data collection and organization of data flow
<ul style="list-style-type: none"> • Lack of reliable baseline data (based either on census data that are too old or on household estimation (whereas IRS estimation is based on the actual number of structures) 	Use more intensive field reconnaissance to gather data and undertake a detailed geographical reconnaissance and door-to-door structure count, serialization of structures, and coding
<ul style="list-style-type: none"> • Lack of understanding of key IRS indicators at the operational level 	Define and standardize indicators
<ul style="list-style-type: none"> • Lack of proper documentation and improper dissemination of relevant IRS data 	Introduce appropriate tools and technologies to gather and disseminate information
<ul style="list-style-type: none"> • Staff inadequately trained for M&E of IRS 	Train NMCP officials in M&E skills
<ul style="list-style-type: none"> • Some countries had weak MIS (not updated, incomplete data, etc.) 	Set up new IRS M&E systems based in country offices
<ul style="list-style-type: none"> • Limited NMCP/MOH capabilities in M&E 	Train NMCP/MOH counterparts through mentoring and through learning-by-doing
<ul style="list-style-type: none"> • Lack of coordination between IEC mobilizers and spray operators 	Enhance integration of these activities (joint coordination, harmonization of activities/synergy)
<ul style="list-style-type: none"> • Poor data collection tools at the community level 	Harmonize and ensure proper use of data collection tools
<ul style="list-style-type: none"> • Non-use of technology to ensure quality, cost-effective, and efficient data management 	Employ new technology and safeguards in data collection, collation, and entry (e.g., cell phones, GPS, PDAs)

3. Implementing a Standardized M&E System and Piloting Innovative Approaches

3.1 Enhancements made to the M&E system

In support of a more systematic assessment of IRS operations at the country level, RTI embarked on updating the M&E tools and systems to meet the challenges of an expanding IRS program and to improve the quality of IRS M&E. RTI developed and introduced a package of support mechanisms and tools to strengthen IRS capacities in monitoring and reporting in all countries where RTI was implementing IRS operations. To facilitate introduction of this updated package, all country offices were asked to allocate adequate resources to M&E. The package of support mechanisms and M&E tools described here was introduced incrementally.

3.1.1 Development of a comprehensive M&E plan for IRS

Each IRS country program must develop an M&E plan and follow it. The plan complements the annual workplan and assists in mapping and coordinating M&E activities. Planning and management of activities takes place within the context of how best to meet project objectives.

An IRS M&E plan should be dynamic and integrate M&E as a daily activity, providing the ability to refine and modify activities. It covers a broad range of issues:

- Baselines for IRS targets and indicators to be measured
- The availability of necessary personnel, equipment, and material resources
- Responsibility for both data collection and oversight of the monitoring process
- Capacity building in IRS M&E
- Data flow systems that will carry accurate and timely information from the spray operator level to the central level
- Monitoring information sources and frequency of data collection
- Strengthening of data management, assurance, and reporting systems
- Data security and storage systems
- Entomological assessments and insecticide resistance testing for IRS program monitoring

3.1.2 Implementation of SOPs and harmonization of indicator definitions

The M&E team reviewed and updated the M&E standard operating procedure (SOP), which includes standards of measures and indicators. The indicator sets were then clearly defined to assist country projects with operationalization and interpretation. Indicators measured across PMI countries require harmonization to promote coherence (i.e., to ensure that definitions are understood, correctly interpreted, and accurately reported), but at the same time require appropriate customization or contextualization for each country situation.

One example is a clear definition of what constitutes a “structure” across PMI focus countries. A structure is the unit of analysis for IRS operations; however, there have been observed differences among countries in the definition, with interpretations ranging from rooms, households, homesteads, to houses and buildings. The term “structure” needs to be understood according to the local context, while conforming to a definition that can be compared and aggregated with data across all IRS countries. In defining it, country-specific caveats were introduced.

Another problem was determining the denominator for calculating coverage rates. The correct denominator is the actual number of sprayable structures found in a target area. The projected number of sprayable structures that program staff expected to find (and thus used as the basis for planning of operations) should not be used in determining coverage.

3.1.3 Enhance M&E capacity to collect, organize, and report IRS data

RTI developed, updated, and disseminated IRS manuals. *The IRS Trainers Guide* and *Standard Curriculum for Indoor Residual Spraying* include sessions on data collection, monitoring, and reporting of IRS data. Training in IRS application and M&E is provided to all cadres of spray personnel before spray rounds begin. M&E sessions are held at different levels of training (e.g., training of trainers, IEC community mobilization, spray operator training). The Ministry of Health (MOH) and NMCP staff are also trained in M&E, and they, in turn, train IRS staff (e.g., mobilizers, supervisors, spray operators, and support staff). Training topics include the following:

- IRS definitions, roles, and responsibilities
- Understanding the core IRS indicators and key definitions
- Maintaining adequate and reliable program data records
- Use of IRS data cards and database—recording, compiling, validating, data entry, and data security
- Performance monitoring in IRS
- Accurate, consistent, and timely reporting

The program also trains data entry staff in the use of the IRS database. These sessions entail practical skills on how to use the IRS M&E systems (i.e., how to start the database program; open the data entry screens; enter data from the paper forms; and validate, back up, and transmit the data). Data managers are trained on how to operate the system; import data; organize, compile, and manage the centralized database; and prepare summary reports, including the weekly tracker.

Achievements

- Development of a pool of skilled staff in data collection, reporting, and data management
- Improved collaboration on joint efforts and information sharing
- Improved data recording and reporting

3.1.4 Improving performance monitoring and reporting

RTI adopted a more systematized reporting structure and format across IRS countries to harmonize reporting on IRS indicators. Country teams use weekly briefs, weekly spray trackers, semiannual reports, and SPRs to inform NMCPs, relevant partners, and PMI of program status. The teams established regular feedback mechanisms on processes, challenges, and potential obstacles to achieving in-country IRS objectives and adjust their activities in response to this feedback.

RTI introduced an integrated approach to improve coordination of IRS field activities through the development of joint operational plans between mobilizers and spray operators. At each operational site, mobilizers and spray operators were encouraged to identify one field coordinator, or focal person, to coordinate IEC and spraying activities. At the end of each spraying day, supervisors of both IEC and spray operations meet to reflect on the successes and challenges encountered during the day or week. They exchange notes from the field, discuss key highlights, and produce action points. They review the spray plan and adjust if necessary. These meetings help teams to understand how IEC and IRS spray operations interact. Improved coordination aims to improve quality, coverage, and efficiency.

Field coordinators and supervisors monitor IRS operations in their areas to ensure that activities are carried out accurately and punctually. Field teams report on specific activities and adherence to IRS operations field requirements based on WHO guidelines,⁴ RTI SOPs, and *IRS Best Management Practices*.⁵

3.2 Piloting innovative practices

This section provides a brief description of the innovative approaches piloted and introduced in 2010–2011.

3.2.1 Improving structure count through use of an IRS card for household identification

The IRS structure card (*Figures 1 and 2*) is an innovation in IRS operations and is given to households during the door-to-door community mobilization, before spraying takes place, in lieu of the stickers used in previous rounds. (The stickers often fell off from the weather or were pulled off. They were also more costly because they were printed every year.) The card has all the information that was used in the stickers and serves as an indication that a house has been mobilized. It is stored with the other health cards, and

Figure 1: Sample of IRS Structure Card (Front)



⁴ http://whqlibdoc.who.int/hq/2003/WHO_CDS_WHOPES_2002.5_Rev.1.pdf, publications WHO/CDS/WHOPES/2001.3 and WHO/CDS/WHOPES/2002.5 Rev.1.

⁵ *President's Malaria Initiative BMP Manual*. http://www.pmi.gov/technical/pest/bmp_manual_aug10.pdf

household members are asked to present it during IRS operations.

Figure 2: Sample of IRS Structure Card (Back)

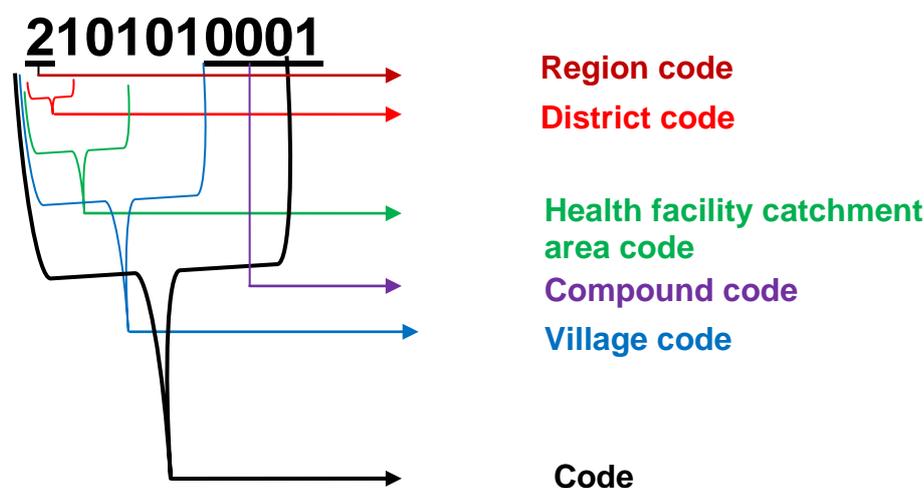
	2010	2011	2012	2013	2014
Number of structures					
Mobilization Date					
Name of Mobilizer					
Date of spraying					
Name of Spray Operator					
Date of Supervision					
Name of Supervisor					
Supervisor Signature					

The IRS structure card has a unique house identification number (HIN), which not only identifies the house, but also is used as a quality control tool. Geographical administrative areas are given unique codes (preferably codes that are used by government systems) to identify them. This unique identification makes it easy to retrieve information needed for a particular administrative area and homestead,

either for data audit or for surveillance purposes.

Example of Mali: *Figure 3* provides a sample of compound coding for compound No. 0001 from the village of Chula (210, 101) in the health area of Chola (2101) in the district of Koulikoro (21) of the Koulikoro region (2) of Mali.

Figure 3: Sample Mali Structure Code



Interpretation of the above coding

In the database, the code of the compound will include 10 digits whose meaning is as follows:

- The first digit is the number (coding) of the region.
- The second digit gives the number of the district in the region.
- The first two digits taken together give the code of the district.
- The third and the fourth digits give the number of the health facility catchment area within the district.
- The first four digits together indicate the code of the health facility catchment area.

- The fifth and sixth digits are number of the village in the health area.
- The first six digits together indicate the code of the village.
- The four last digits are the number of the compound in the village.

3.2.2 Implementing an electronic IRS information management system (IRS relational database)

From 2005 to 2009 (IRS 1), RTI used spreadsheets to record IRS data. In 2010, RTI adopted the use of a relational database (Microsoft Access) to develop an IRS data entry and reporting system to manage IRS information at all levels of the program. This was in line with RTI's emphasis on strong management of information for ensuring quality data management, specifically to minimize the opportunities for error and infuse efficiency in the process of data entry and report generation. The database is used to collect, analyze, and report on IRS data from the field to USAID/PMI and local partners, including MOH/NMCP.

The database is meant to capture a wide range of data, including data on training, IEC, spray operations, insecticide distribution and use, and some entomology data. The database has built-in screens to assist data clerks in verifying every entry. The database also has built-in queries and reports with daily targets for program management.

The system is set to automatically calculate data by categories requested; it also captures mop-up data separately from principal data and aggregates them. This separation helps to avoid double counting. One component of the revised M&E data system is the direct entry of spray data from the primary source (i.e., daily spray operator cards) into the database with a goal of reducing manual compilation errors. The database was initially field tested in Rwanda, Mali, and Mozambique and, based on successful implementation, was introduced to all PMI-supported country programs implemented by RTI.

At the country level, the IRS M&E systems are housed at either a district government facility or a district IRS office for quick feedback to and from spray operators. The district/regional databases feed into the central database. The system requires skilled M&E staff and internet connectivity for transmission of daily data reports.

The IRS structure card has a unique identifier and includes the number of structures in each household. This information is entered into the database as the number of "structures found." The spray operator records that unique HIN and the structures he or she has sprayed or not sprayed, as well as all other information (e.g., population, children under five years of age, pregnant women) that is not pre-entered. These data are entered at the peripheral offices and transmitted to a central database. The mode of transmitting data from the field was changed to use queries that convert the tables needed for updates into Microsoft Excel format. These are smaller files and easier to send by e-mail.

Advantages of the M&E database include the following:

- Microsoft Access-based data entry allows data checking at the point of data entry, as formulas/macros are incorporated to reduce data entry errors and

validate entered data (e.g., through range checks and data consistency checks). Data managers can easily review entries and perform tabulations and listings in the field to assess data quality.

- Data from all field teams are aggregated into a single database, allowing for the generation of a daily preliminary report of spray coverage, showing all of the structures/households in a chosen time period by their spray status.
- The data security has in place an audit system that tracks which staff member entered each record. This system enables supervisors to monitor the performance and accuracy levels of individual data entry staff.
- Within the database program, data security is improved, with both the program and database automatically stored. A button for data backup allows information to be backed up every time a new field is opened.
- The system allows users to detect problems early and make decisions quickly and enables managers to find out easily which spray operator sprayed which structure or compound.

Strengths. The IRS database features the following added strengths:

- All queries and summaries of data are done via icons activating macros integrated into the application. Thus, besides clicking on the macros, no further action is needed by the data clerk for sending data and reporting IRS information at the district level.
- The program is efficient, allowing direct entry of data from spray operator forms into the database (reducing manual compilation errors), and it has the ability to group and transform data into report summaries. The system can automatically calculate data by any category requested.
- The system can link a structure sprayed during “mop-up” (a second visit) of the regular spray campaign data (the first visit). The system automatically revises and merges this information, thereby reducing the possibility of double-counting.
- Data are easily sent to the central level and back to district stakeholders, such as district health offices, IEC partners, and RTI field staff through daily/weekly summaries. The purpose of these communications is to use the data as a quality improvement tool.
- District-level staff are able to run their own quick analyses using simple queries.

Challenges. The Access-based system faced a number of challenges (e.g., capacity and use of IT), including some of the following:

- Overall the new system increased the workload over the previous system.
- A higher number of data clerks is required per site.
- The system requires a fast running internet connection to transfer data from the district to the central level. Poor internet connectivity has been a limitation to timely submission of data reports.

- Experienced staff with specialized skills are required to use MS Access.
- Installation, management costs, and complexity are factors in deciding to implement this system.

System issues. A few operational glitches were observed that required immediate troubleshooting at the field level:

- Where codes are not aligned, data will not upload correctly.
- Data clerks forget to amend the names and codes in the system to reflect changes/transfers.
- Errors occurred when uploading files transferred.
- The system slowed down because the database handles large amounts of data.
- Computers did not have the correct software programs or compatible operating systems.
- Machines in the field needed antivirus software for protection.
- Troubleshooting skills are needed to correct bugs in the system, including issues with dropdown menus, types of reports to be used, and incorrect tab order.

Most of the issues that were identified during and after field testing were resolved.

3.2.3 Piloting the pre-entry of IRS structure information (Mali, Benin, Rwanda, Mozambique)

To improve IRS data collection, RTI piloted a pre-entry system. The system reduces the data collection burden on spray operators, allowing them to focus on quality spraying. Below are the key steps followed by the IRS teams that piloted the strategy.

Select and train mobilizers and their team leaders: RTI worked with NMCPs to identify IEC mobilizers from within communities being sprayed to conduct community mobilization. The criteria for selection of grassroots partners often included their involvement in mobilization-related activities and their geographical reach (up to the village level). The criteria for selection for IEC mobilizers included their residency, knowledge of the area, good conduct and respectability, familiarity with mobilization activities, and basic numeracy and literacy. Team leader criteria also included residency, knowledge of the area, good numeracy and literacy, and having undergone training on IRS application, structure identification, and data collection.

Mobilizer training: After the above criteria were met, IEC mobilizers and their team leaders were trained on the IRS communication strategy, structure identification, data collection of demographic characteristics of target population, and issuance of IRS structure cards and brochures. The trainings for mobilizers included practical sessions on how to conduct door-to-door household visits to explain IRS, sensitize the household members on their roles and responsibilities in preparing their houses for IRS, distribution of IRS brochures and the IRS household or structure card, including actual data collection.

IEC mobilization and structure enumeration: Mobilizers visited communities to talk to families about IRS (key messages on community responsibilities before, during,

and after spraying) and provide the spray dates. These messages also were disseminated through other communication channels such as local radio, village elders, megaphone/criers, and other forums (e.g., market days, chiefs' meetings, and other community events). Once IRS acceptance is established, the mobilizer issues the IRS card and notes the unique number on the card that identifies the household, records the name of the household head and the number of eligible structures associated with the number on the structure card. Mobilizers then mark each eligible structure using chalk or permanent ink, writing down the unique number from the IRS structure card. Once an IRS structure card is assigned and the markings done, the mobilizers then collect and record all the relevant demographic characteristics of each eligible structure on the mobilizer register. The information collected corresponds to the core indicators of IRS: the number of structures found, number of people residing in the structure identified, number of children under five years of age, number of pregnant women residing in the structure, number of mosquito nets, number of brochures issued, and IRS acceptance. The mobilizers then sign the IRS structure card to indicate mobilization has taken place and hands over their daily/weekly reports to their team leaders to verify that data are complete.

Data entry clerk training: The recruitment and training of data clerks is conducted as mobilization and structure enumeration is coming to an end so that immediately after mobilization, trained data clerks can start entering data into the database. Data clerk training includes a one-day discussion session covering data entry and data management and security; days two through five include practical sessions where data clerks practice entering mobilization data into the IRS database.

Data collection during spray operations: During the actual spray campaign, spray operators are given each week a printout of the mobilizer register of their area of operation. The register provides a list of all structures in each village, along with the name of the household head and the unique identification number of their assigned structures. This information, combined with the markings on eligible structures, guides the spray operators in quickly finding and spraying the structures. The use of the register speeds up spray activities, making it easy to find the eligible structures. Once a structure is sprayed, that structure is marked (on the wall or under the eaves) to indicate that the structure had been sprayed. The daily spray card is completed and submitted to a supervisor for verification and forwarded to the data clerks for entry.

Data entry and transmission: The data entry clerks update the IRS database daily with records received from the field. The data clerks are provided with a checklist to ensure all fields have been completed, and those fields with obvious errors are returned for verification. When all the records for the day/week are entered into the IRS database, the data manager auto-generates a report providing information on structures sprayed and those not sprayed.

Quality assurance: Using quality assessment tools, supervisors and staff from the MOH/NMCP conduct periodic spot checks at operational sites to ensure that IEC mobilization and spraying activities are conducted according to IRS standards and that the collected data are complete and correct. The M&E team also performs random checks to validate the integrity of the data entered into the IRS database.

Daily and sometimes weekly debriefing meetings are held to discuss any operational or data quality challenges identified and to ensure they are promptly addressed.

Lessons learned

- Structure count and mobilization activities should start early, at least a month before the spray campaign, to ensure that a complete structure register/baseline count is ready.
- There must be clear understanding of the definitions of the terms “household” and “structure.” These definitions can have serious implications on the data collection, entering, and processing/analysis.
- Errors are reduced if the HIN is also inscribed on the eligible structures in addition to the structure card.

3.2.4 Piloting cellphone-based short message service technology for IRS (Ghana and Ethiopia)

RTI has been using paper forms to record data in IRS at the point of collection. The short message service (SMS) system, however, uses mobile phone technology to record data from the field and transmits the data to an IRS database. The system uses a browser-based application for data management and reporting.

Introduced in 2011 in Ghana and Ethiopia, the system comprised the following main components:

- *SMS Data Service* – Uses local mobile phone technology to enter data on mobile phones in the field and transmit the data to a server
- *Management and Reporting Portal* – A browser-based management and reporting portal that views and produces reports on submitted data and provides authorized users administrative access to system components

The home screen of the SMS data system (*Figure 4*) provides access to all functions of the system; users log in to access any of these system functions. A user’s account allows the user to log in to the server application and manage the application. All actions the data manager executes on the system are logged for

audits of system usage and access. More than one data manager can log in simultaneously, but only from different stations, and each user’s actions are logged separately. The system has predefined types of users: enumerators, supervisors, team leaders, squad leaders, spray operators, and mobilizers. Users’ ability to access certain functions or enter or change data is based on their user type.

Figure 4: Home Screen of the IRS SMS Database

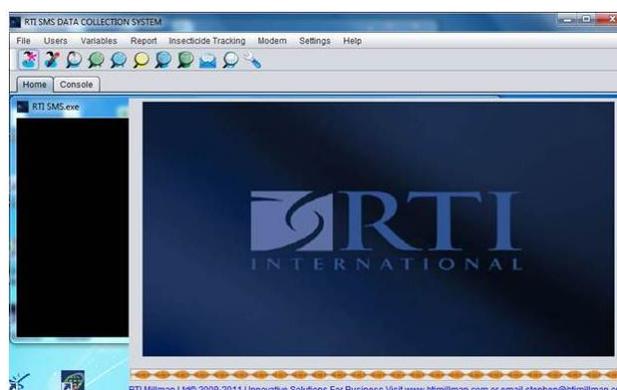


Figure 5: A Sample View for Creating a New User

Users are registered into the system using their mobile phone numbers (**Figure 5**). All users' IDs are auto-generated to ensure uniqueness. At least two names are required when creating a new user.

Mobile service numbers for sending data are provided to all users for sending data through SMS. These service numbers can be from any of multiple service providers to maximize the

probability of the data being sent through by choosing the provider with the best coverage for a given area.

Sending data through SMS: The RTI team developed job aids to guide users on how to enter and send an SMS message to the central database.

Squad leader sending SMS messages to the central database, Ethiopia



The team leaders/spray operators replace the coded message with the actual value for each data field; for yes/no responses they replace with either *y* for *yes* or *n* for *no*. They then send the message to the provided service number using their personal registered number. Once the system has successfully saved the data, the team leader or spray operator will receive a message saying “SOPn data saved successfully. For reference use ID: xx.” They then enter this ID in the hardcopy daily spray card that is sent to the data manager for crosschecking.

If the data are not saved successfully, the team leader/spray operator will get an error message that will attempt to troubleshoot the error (e.g., “POP should be a number”). The team leader or

spray operator should correct the error and resend the text until he or she receives a success message (indicating the dataset has been updated with this ID). When the data are successfully sent, the error message is then replaced by a new message that reads, “SOPn data saved successfully,” and that is the final log of that data record.

All information from the team leaders is relayed to the centralized SMS system mail inbox. Once data are sent successfully, the software data manager automatically receives the data into the RTI database. The database is robust enough for query and generating reports, including all analytical functions that come with MS Access 2010 software.

The report views allow the user to do the following:

- View the details of one data object via the popup menu that comes up when the data object's row is clicked
- Update the details of one data object via the popup menu that comes up when the data object's row is clicked
- Delete a data object via the popup menu that comes up when the data object's row is clicked
- Print the entire view
- Export all data in the view to a Microsoft Excel file for importing into other applications (The Excel file is stored on the desktop of the PC user.)
- Refresh the data in the table if the data are updated from another station

Data views are auto refreshed on successful receipt and processing once the system successfully receives and processes the corresponding message from the registered field officers.

The user can export the entire data set in the report view to a Microsoft Excel file for dissemination or for importing into other applications. The Excel file is stored on the desktop of the PC user.

To successfully facilitate software deployment, RTI developed a number of resource materials and performance support tools, including the following:

- *SMS Installation Guide*: This guide shows how to use the system, from installation to exporting all processed data successfully.
- *RTI SMS Data Collection User Manual*: This manual is for the data managers, who administer the application.
- *Performance support tools*: These tools define messaging formats for sending respective data. They are in the form of short instructional IRS data entry and transmission job aids covering areas such as baseline structure count, IEC and community mobilization, spray operations, and insecticide distribution and consumption.

Advantages

The first advantage of this data entry system is cost. Mobile phone communication infrastructure is in place in most countries where PMI is supporting malaria prevention and control efforts, and phone ownership is becoming nearly universal among adults. There is very little capital cost to using this system.

The database can hold large amounts of data and also be used to aggregate data into simple charts and graphs. The system enables web-based access to reports and data. There is immediate notification to the sender of successful receipt of data. SMS can be used to “top up” data collectors’ phones as well, ensuring they have sufficient calling time to remit data. SMS can be used to send other program-related information immediately to all stakeholders. SMS also can be a two-way communication; those in the field can respond to SMS text messages and vice versa. SMS can be sent from any

phone, with no need for expensive smart phones or laptops; received data can also be analyzed and results relayed the same way.

The SMS system can be up and running quickly and uses existing manual data collection forms as its starting point. User training takes only about two to three hours.

Challenges

Challenges encountered implementing the SMS system include the following:

- The poor wireless phone network system in Ethiopia caused delays in transmitting data.
- Internet connectivity is unreliable in much of rural Africa.
- Availability of phones was an issue, with some spray operators not owning phones.
- Manuals and guides need to be translated.
- Electricity was often unreliable to recharge phones.
- The server was slow, and responses to SMS messages were often delayed. The server would time out (sleep), requiring someone to refresh the system constantly.
- When data saturated the system, the server would jam and stop.
- The number of error messages was high, bringing into question the reliability of data sent.
- The system does not differentiate mobile operator-generated messages and advertisements (spam), so the former are not recognized or screened by the system and as a result block the system.
- The lack of a real-time interface between the server and the spray operator sending the data resulted in server delays in accepting data. Where this occurs and there is a data error, the spray operator will not know. Even if the data packet has already been sent, the operator will not know until the next day. These delays create problems in resolving errors.
- Many spray operators send data to one server at the same time—often in the evening, after spraying is done—making it impossible for the system to send feedback to the person submitting data.

Lessons Learned

The lessons learned from the pilot phase are strong foundations upon which programs can consider or adopt the SMS IRS database for IRS data reporting. This technology is evolving and changing rapidly. When RTI first used it to transmit disease data in Zanzibar, the system required specially programmed SIM cards, meaning that only certain phones were capable of transmitting data. If these phones were missing or not charged, then no data were transmitted. Now almost any phone will work in transmitting SMS data without any modification required. As networks expand and become more reliable, SMS transmittal of data is becoming easier and more common.

- The system would be good in environments where the network is more reliable and the capacity is higher.
- To successfully facilitate software deployment, countries need equipment, materials, and adequate controls in place for implementation.
- User manuals and job aids are required to enable the users to understand the sequence and deploy the task better.
- More training is needed to test the system and practice before spray operations begin.
- In the future, spray operators should enter the data instead of squad or team leaders.

3.2.5 Geographical Information System (GIS) for data collection

A Geographical Information System (GIS) is a system for gathering, storing, analyzing, presenting, and generally managing geographic data. For IRS operations, GIS assists in developing detailed maps of target districts, indicating locations of houses and other landmarks that will improve IRS operations and planning.

Interviewers or operators are given a preprogrammed personal digital assistant (PDA) equipped with a global positioning system (GPS). The PDA collects geo-coordinates, population data (number of pregnant women, number of children under five years of age), and other data (number of ITNs, spray status) about households. The system integrates common database operations such as query and statistical analysis with how data relate to space and time. Collected data are downloaded and mapped to show sprayed zones, population density, and the spatial presentation of spray coverage. The PDA helps in navigating back to a household and facilitates obtaining a random sample during surveys.

In Kenya this system has been used for planning interventions for malaria control and gathering information to define IRS target areas and collate information on populations associated with mapped structures. This information is then used to quantify insecticide and other resources required during IRS operations. During spray rounds, the information is used to track sprayed structures.

Ethiopia has also mapped and geo-coded IRS operations. The new system uses mapping and geo-coding to update population and sprayable surface area data for each district for the purpose of proper targeting of IRS operations and for procurement. The system uses population data collected using PDAs and structured questionnaires. Each house is geo-coded with reference points using GPS. Structures are measured and surface areas calculated with formulas incorporated in the PDAs. Senegal also recently piloted the use of PDAs for data entry at the spray operator level. The district of Koumpentoum was selected as a pilot area, and three models of PDA use were implemented, each with a different staff person using the PDA: spray operators, non-operators, and team leaders. Several issues emerged with the central database after a routine data quality assessment and district-by-district review of all data sets, and some errors were found in all district databases.

Advantages

Advantages of the system were as follows:⁶

- Allows for rapid mapping of all household units and other features of interest in an enumeration area
- Allows for multiple users to share mapping duties and for combining of files
- Enables rapid aggregation of information from various interviewers (If standard questionnaires are used, standard analysis programs can also be used, allowing rapid preliminary analyses.)
- Can map other features of interest
- Can calculate a statistical sample of households—simple random sample or cluster sample
- Allows easy navigation back to households chosen for the sample (The device can export the locations and identifying information for the selected households to a GPS navigation program that guides interviewers back to the households in the sample. Interviewing can also be done by multiple persons.)
- Can guide an interview and skip over questions that are not appropriate for the particular respondent (skip patterns are preprogrammed) and enter data that are checked as the data are entered
- Can safely store the data
- Can export a data table into virtually any GIS product to produce spatial analyses or maps (Pre-existing mapping data can also be used in these analyses. It is easy to send data to a laptop or desktop PC for rapid aggregation and rapid preliminary analyses.)

Challenges

Some challenges have been identified in using PDAs for data entry from daily spray cards:

- Technical resources (software)—Glitches were encountered with the PDA software (e.g., coding errors, debugging of problems, leading to delays in reporting).
- Errors in recording data—Some spray operators improperly filled out the forms; in most cases, they skipped fields or repeated the same information.
- Data synchronization was slow—The high volume of data caused a slowdown in data entry, and team leaders needed to validate data before entry; data entry speed improved as the campaign progressed.
- Cost—Because of the hardware and software requirements, intensive training of personnel, and the necessity of georeferencing every household, use of PDAs in IRS operations is comparatively expensive.

⁶ List adapted from the Roll Back Malaria *GPS Field Manual for Data Collectors*.

Resources required

- Human resources, including trainers, trained mappers, data clerks, supervisors
- Vehicles
- Communication airtime
- GPS devices, computers, working database, data (spatial and attribute)
- Software

Lessons learned

- It is easy to visualize data through GIS. However, GIS alone is not sufficient, and statistical analysis of the data is still required.
- Accurate data are needed for GIS to be effective.

3.3 Summary of lessons learned

IRS 2 made significant improvements in M&E. These improvements stem from the project placing a higher priority on M&E, creation of and training in use of better tools for M&E, and more stringent controls and quality assurance. The following are key experiences from which the IRS program learned valuable lessons:

1. Cultivating an “M&E culture” is hard work, but yields results.

When comparing across countries, it is evident that most of the improvements in reporting and quality of data occurred where learning and accountability were strengthened. IRS country projects recruited qualified M&E “focal point persons” as one way to improve the quality of IRS M&E and to accelerate movement toward a culture of accurate and timely results. With such a culture, value is placed on learning and the recognition of mistakes as useful steps in improving. A learning culture motivates those involved in project implementation to learn from their experience and apply those lessons to the improvement of the project.

2. Integrating M&E planning into a comprehensive IRS operational plan is essential for ensuring that M&E is adequately resourced and staffed

The M&E plan should integrate M&E as a daily activity. It should feed information back into the planning system quickly and regularly, creating the opportunity to refine and modify activities, depending on the information coming in.

3. Reviewing and standardizing tools across IRS countries ensures consistency and increases quality in data recording and reporting.

Have clear objectives and indicators: M&E requires clearly defined and appropriate indicators. Indicators are the link between the objectives (which are stated as results to be achieved) and the types of data that need to be collected and analyzed through M&E. Any assessment of the IRS project, whether through monitoring or evaluation, must be based on objectives (i.e., what the interventions aim to achieve).

Be mindful of the IRS terminology: USAID/PMI has specific guidelines for indicator measurement and interpretation. Where there is no consensus of an understanding of key IRS indicators at the operational level, there is need for re-defining of indicators,

adjustment of baselines, and means of verification for IRS projects. Staff must understand the definitions and parameters of project indicators and adhere to them.

The definition of “structure”: The structure is the unit of analysis for IRS. The definition of this term should be clear, well understood, and consistently applied. Also, the concept of a structure needs to be understood according to the local context. RTI has worked with country projects to harmonize and ensure the definitions are understood, correctly interpreted, and accurately reported.

4. A country IRS M&E systems should ideally be built upon the national (MOH or NMCP) system to eliminate duplication and reduce the burden on all parties concerned.

Chiefs of party in several countries sought ways to ensure that their M&E requirements work through the national health management information system (HMIS) or other malaria-specific monitoring system. Not all governments, however, have the full capacity to carry out adequately the responsibilities for M&E. In such cases, RTI can assist the governments (where possible and where staff are interested) to strengthen their M&E capacities.

5. Accurate, adequate IRS information must be generated within a limited time frame.

Time constraints and the quality of M&E: Monitoring actions have been a challenge because of limited staffing to conduct site visits regularly to obtain or verify information and because of the long travel distances between the operational sites. The timelines for spray campaigns are short, and M&E officers and district coordinators often do not have enough time to conduct all desired field site visits. Budgetary provisions must be made accordingly for all monitoring actions and DQA exercises.

6. Quality checks are instrumental in enhancing the quality of data collected and the quality of spraying.

Through site visits and spot checks, supervisors and coordinators were able to identify evolving problems, provide corrective measures, and revise plans. During site visits, supervisors and coordinators were able to meet with field staff to discuss results. Regular monitoring is required to be able to identify problems when they first appear and to ascertain the accuracy, reliability, completeness, and integrity of data.

7. Working through community groups, community health workers, village elders, and locally recruited spray operators builds communities’ sense of ownership of the IRS program.

Orienting village elders on IRS operations has enabled them to actively participate in vetting staff and recruitment, following up on household registration, and tracking mobilization and other spray activities within their villages. IRS operational site managers should meet with community members to make sure that community members’ information needs are being addressed. The site managers should share the weekly activity plan with the spray operation team and village leadership.

8. It is important to pre-test the data tools and database and re-test when significant changes are made.

As the IRS database system was implemented, the forms and processes underwent changes. Because of the changes, it was important to train staff on the use of the system and to inform all staff about the system and how it works. When changes are made, the relevant tools(s) should be tested and adjusted if necessary. Similarly, the M&E SOP should be updated to reflect the new or revised tools. The process of field testing identifies questions that are unclear, ambiguous, or otherwise not likely to yield desired information.

The forms and the database may have to be translated into one or more local languages. It is important to spend sufficient time on this step to ensure that all data gatherers and clerks are interpreting the questions in the same fashion so that data collection is consistent and reliable.

A significant challenge in data management using the IRS database is the data backlog reported in many countries. To minimize errors and improve accuracy of collected data, primary data were entered directly into the system. However, over time, the large volume of primary data to be entered and analyzed created some backlog. The process of double verification also slowed the data management process, and as is found with most new system deployment, start-up challenges also slowed the data entry process. Because this is a new program, more vigilance is required in monitoring the quality of data being entered and reported to ensure accuracy in results disseminated.

9. The findings of the DQAs are very useful for strengthening IRS data management and reporting systems.

Reliable information based on high-quality data is essential for effective IRS operations. For example, without a cohesive database management strategy, rigorous control of data inputs and amendments, and equally rigorous quality management, inaccurate, incomplete, or poorly formatted data will find its way into the database.

In 2010–2011, RTI has been involved in DQA exercises in Benin, Mali, Mozambique, Angola, Rwanda, Ghana, and Ethiopia. The aim of these DQAs was to verify the quality of reported data for selected indicator results at selected sites, to assess the ability of data management systems to collect and report quality data, and to ensure adequate procedures were in place to validate IRS data. Data audits were a new experience for many program staff and, at times, were seen as “policing.” They bring to light the condition of the data at many levels (duplication, cleanliness, deliverability, process compliance, and data-related findings such as displacement of data).

10. The use of the IRS structure card for structure identification, providing structures with a unique ID number prior to spraying, improved IRS data quality and operations management in many of the countries where it was piloted.

The unique structure ID links the geographical location with the structure, creating a more accurate baseline count of target houses in a spray area. This information helps in micro-planning and mop-up activities. The use of unique IDs has also enabled country projects to link IRS spray operators to specific geographical areas and structures, contributing to better logistics and spray operator performance assessment. There have been problems, however, with the poor condition in which household members kept the cards, leading to rapid deterioration of some IRS structure cards. Some cards went missing, and others were illegible and needed replacement. A better quality of IRS structure card or physical protection of the card should be reviewed. An evaluation is needed for the use and effectiveness of the structure card in contributing to the overall improvement of the process.

11. The success of using cellphone-based SMS technology for IRS depends on a threshold level of telecommunications/Internet infrastructure.

The need to send SMSs daily from the cellphones was crucial for feedback and to promptly address errors, but communication was a severe problem in the remote districts of Ethiopia due to lack of connectivity. Many African rural settings are poorly connected in terms of Internet connectivity and telephones, rendering the system ineffective (or nearly so) in resource-poor settings. The use of SMS technology for IRS should be explored further, especially for countries with good telephone and Internet connectivity even in rural settings, where IRS often takes place.

12. To successfully facilitate SMS data reporting deployment, countries need equipment, materials, and adequate controls in place for implementation.

Because the SMS data system is a software application, user manuals and job aids are required to enable the users to understand the sequence and deploy the task better, thereby improving overall use and efficiency.

13. Use of Geographical Information System mapping is a valuable tool for linking data to structures and for surveillance and response.

Mapping and geo-coding is useful in IRS. Mapping helps with planning, resource allocation (e.g., the daily output of sprayers), and team organization for the operations and accessibility of target structures. Although it is easy to visualize data through GIS, visualization alone is not sufficient. Statistical analysis is still needed. It is best to download data from PDAs daily for feedback and to address errors promptly, but communication is a problem in remote districts due to lack of connectivity. Frequent interruptions of electricity (and therefore battery charging) contributed to delays in reporting.

Annex A: Key Informants Analysis Tool

Purpose: The purpose of this exercise is to document any lessons learned on the M&E data management component during the implementation of the IRS project that can be successfully applied and shared in other projects. When completing the table below, we need to ask the following questions;

1. Specifically, what was your experience using
 - (i) Data collection, data entry, and reporting of spray operator daily data
 - (ii) The MS Access database
 - (iii) SMS cell-phone-based data gathering
2. Generally, what worked well—or did not work well—either for the project or for the project team?
3. What surprises did the team have to deal with? What circumstances were not anticipated?
4. Were the M&E data management project goals attained? If not, what changes need to be made to improve M&E data management goals in future? Suggest improvements.

Please complete the matrix and feel free to expand the space provided and add comments on any other unique issue from your country/program that might not be captured.

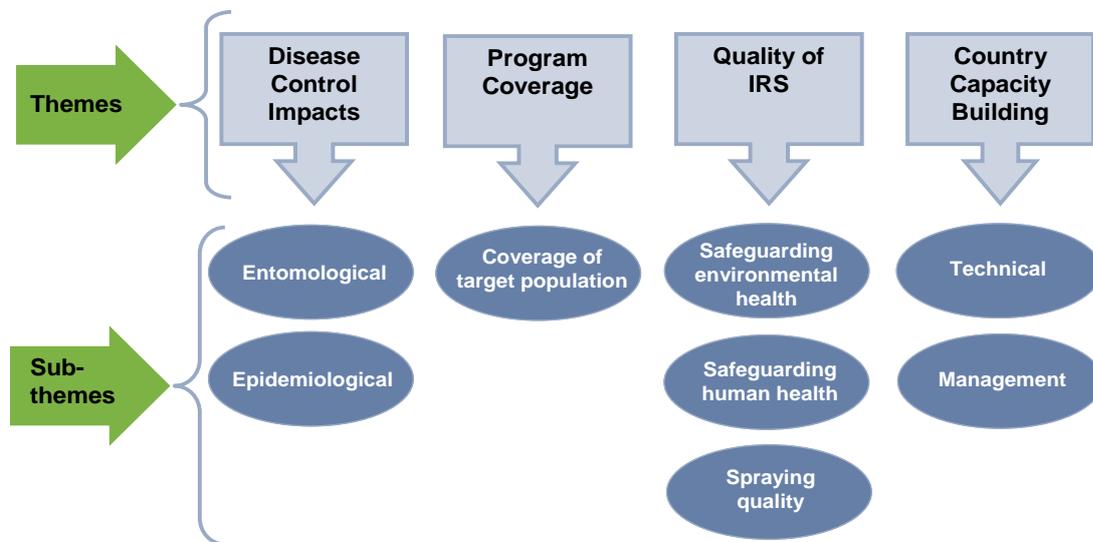
Significant M&E Data Management Successes

What worked well?	What factors supported the success?
What did not work well?	Recommended solutions
What surprises did the team have to deal with? What circumstances were not anticipated?	
What changes need to be made to make M&E data management more effective?	Suggested improvements

Any other shortcomings and solutions on the M&E data management component? (please list)

Annex B: IRS Results Framework

M&E Framework: IRS Program Effectiveness



This annex describes the framework for monitoring and evaluating the performance and effectiveness of IRS 2 implementation in target countries. The framework draws on lessons from IRS 1. It focuses on (1) assessing progress on the implementation of IRS activities, and (2) achievement of vector control outcomes and reduction in malaria transmission.

Annex C: IRS Indicator Matrix

	Indicators	Source	Freq.	Remarks
Core IRS indicators	<ul style="list-style-type: none"> Number of people residing in houses sprayed Number of people trained in IRS (disaggregated by type of training) Number of houses sprayed Percentage of houses targeted for spraying that were sprayed 	Project records and end-of-spray reports	Every spray round; quarterly	Data collected and validated by trained spray personnel
	<ul style="list-style-type: none"> Percentage of vectors susceptible to candidate insecticide (using WHO protocol) 	Project records and reports	Annual	Routine monitoring by trained NMCP technicians
	<ul style="list-style-type: none"> Residual duration of insecticide in months, on substrate sprayed 	Project records and reports	Annual; monthly; quarterly	Routine monitoring by trained NMCP technicians
	<ul style="list-style-type: none"> Number of country programs with a sound insecticide resistance monitoring plan in place 	Project/partner records and reports	Annual	Plan developed by NMCP with project support
	<ul style="list-style-type: none"> Percentage of activities in IRS implementation timeline that are led by local, regional, and/or national governments 	Project/partner records and reports	Annual	Project to support NMCPs to develop capacity for various aspects of IRS
Additional program indicators	<ul style="list-style-type: none"> Number of children under five residing Number of pregnant women residing 	Project records and end-of-spray reports	Every spray round; quarterly	Data collected and validated by trained spray personnel
	<ul style="list-style-type: none"> Morphological identity and behavior of vectors Vector density 	Project reports	Annual; monthly	Entomology surveys; routine monitoring
	<ul style="list-style-type: none"> Number of laboratory-confirmed malaria positive cases in target population Percentage of severe anemia in children under five years in target population Percentage of population ages 5–15 years carrying malaria parasites 	Malaria indicator cluster survey (MICS), demographic and health survey (DHS), MIS, School surveys	Annual; bi-annual	RTI to gather information only
	<ul style="list-style-type: none"> Number of IEC materials disseminated Number of insecticide sachets used Number of IRS commodities (personal protective equipment, spray pumps) procured and used 	Project records and reports	Each spray round; monthly; annual	To be collected as part of program implementation