Malaria Decision Analysis Support Tool (MDAST): Evaluating Health, Social and Environmental Impacts and Policy Tradeoffs

Progress Report for the Period:
January 1, 2011 – November 30, 2011

Submitted to: WHO-AFRO, MDAST Executing Agency
Contact Person: Dr. Birkinesh Ameneshewa

Submitted by Duke University and University of Pretoria on behalf of the project partners shown below:

<table>
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<tbody>
<tr>
<td>Duke University – Duke Global Health Institute</td>
<td>Dr. Randall Kramer</td>
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<tr>
<td>University of Pretoria – School of Health Systems and Public Health</td>
<td>Dr. Clifford Mutero</td>
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<td>Ministry of Health (Kenya) – Division of Malaria Control</td>
<td>Dr. Rebecca Kiptui</td>
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<td>National Institute of Medical Research (Tanzania)</td>
<td>Dr. Leonard Mboera</td>
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<td>Dr. Edridah Tukahebwa Muheki</td>
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INTRODUCTION TO THE PROGRESS REPORT FOR THE PERIOD OF JANUARY 1 – NOVEMBER 30, 2011

PROJECT BACKGROUND:

The Malaria Decision Analysis Support Tool (MDAST) project is working to improve the protection of human health and the environment by promoting sustainable malaria control strategies that are consistent with the successful implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs). The project has been developed in a collaborative manner with various stakeholders involved in POPs implementation and malaria control policy making and implementation, and responds to a need for capacity building for improved policy formulation. The aim of the project is to promote evidence-based, multi-sectoral malaria control policy-making in Kenya, Tanzania, and Uganda, serving as a pilot for other malaria-prone countries. The project employs a comprehensive framework to assess the full range of health, social, and environmental risks and benefits associated with alternative malaria control strategies.

To accomplish this goal, the project is focusing on achieving four main outcomes:

1. Development of a Malaria Decision Analysis Support Tool (MDAST) that jointly incorporates health, social and environmental priorities for malaria control in Kenya, Tanzania, and Uganda.

2. Increased capacity for evidence-based malaria control policy making through the regular use of MDAST in Kenya, Tanzania, and Uganda.

3. Creation of an agenda for policy-relevant malaria research through development of MDAST and identification of key knowledge gaps.

4. Elucidation of requirements for replication of MDAST in other malaria-prone countries around the world.

These outcomes are being pursued through a range of activities including stakeholder and expert consultations, conceptual modeling, policy dialogue workshops, training and information sharing, partnership building, incentives analysis, and identification of knowledge gaps and research priorities. The project is establishing an inter-disciplinary network of practitioners and policymakers, and is building research, monitoring, and analytical capacity to make more informed decisions about alternative approaches to malaria prevention and treatment.
The project partners have made excellent progress on project activities during the second year of the Malaria Decision Analysis Support Tool (MDAST) project. Activities were undertaken in this phase according to the Year Two Workplans, which were defined based on the schedule of activities laid out in the project proposal. Thus, during the second year of the MDAST project, the focus was primarily on Activities 3, 4, 5, and 6. Activity 3 is to identify barriers to implementation of optimal policies and incentives for overcoming these barriers; Activity 4 concerns engaging in country-specific training, testing, and refinement activities; Activity 5 is to use country-specific MDAST modeling in value of information (VOI) analyses; and Activity 6 relates to disseminating project results and lessons learned.

Specifically, in the period of January 1 – November 30, 2011, the project partners accomplished the following:

1) Co-organized and participated in the Second Regional Steering Committee Meeting;

2) Documented barriers to optimal malaria control policymaking and opportunities to overcome them, including through conducting a formal structured literature review, constructing a prototype incentives matrix, and engaging in an institutional analysis that will develop an institutional diagnosis of current problems and what could be done to improve the prospects for new approaches through institutional change (Activity 3);

3) Continued to refine the MDAST tool by engaging in country-specific training and evaluation exercises, which included meetings and consultations with project partners, key policy makers, and technical support entities on the use and modification of MDAST. Duke has applied results and lessons learned from these evaluation exercises towards further key model developments of MDAST (Activity 4);

4) Researched and devised a plan for conducting value of information analyses (Activity 5);

5) Worked to disseminate project results and lessons learned, including through a meta-analysis on a key malaria control intervention (IRS) employed in the model, and in-depth comparative analysis of stakeholder survey results by project country (Activity 6);

6) Participated in, reviewed, summarized, and responded to the external Mid-Term Review.

The deliverables and their location within this progress report are as follows:
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# REPORT OF THE SECOND MEETING OF THE PROJECT STEERING COMMITTEE

10 MARCH 2011
PROTEA COURTYARD HOTEL, DAR ES SALAAM, TANZANIA

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1. BACKGROUND

The Malaria Decision Analysis Support Tool (MDAST) project is designed to improve the protection of human health and the environment by promoting sustainable malaria control strategies. The project has been developed collaboratively with various stakeholders involved in malaria control policy making and implementation, and responds to a need for capacity building for improved policy formulation. The project’s aim is to promote evidence-based, multi-sectoral malaria control policymaking in Kenya, Tanzania, and Uganda. It is intended to serve as a pilot for other malaria-prone countries, through the use of a comprehensive framework for assessing the full range of health, social, and environmental risks and benefits associated with alternative malaria control strategies.

The second meeting of the Project Steering Committee (PSC) was held on March 10, 2011 at the Protea Courtyard Hotel in Dar es Salaam to: (1) Review and discuss progress made in Year 1 of the project, including stakeholder workshops, key stakeholder survey results, and MDAST tool development; (2) Review and discussion of Year 2 project activities, including stakeholder workshops and plans for further development of the MDAST model, and (3) Discuss coordination and the roles and specific contributions expected from the key project partners.

2. COMPOSITION OF THE PROJECT STEERING COMMITTEE (PSC)

The PSC is comprised of representatives from the following key project partners:

- UNEP/GEF Coordination
- WHO-AFRO
- Duke University
- University of Pretoria
- Ministry of Health, Uganda
- Ministry of Health, Kenya
- National Institute of Medical Research, Tanzania

The following Steering Committee members were present at the second PSC meeting:

- Birkinesh Ameneshewa, Regional Vector Control Operations Officer, WHO-AFRO (Chair);
- Jan Betlem, POPs Task Manager, GEF Coordination, UNEP;
- Randall Kramer, Professor, Duke University;
- Clifford Mutero, Senior Researcher, University of Pretoria - School of Health Systems and Public Health;
- Leonard Mboera, Chief Research Scientist, National Institute of Medical Research, Tanzania;
- Narcis Kabatereine, Head Vector Control Division, Ministry of Health, Uganda;

Note: (Rebecca Kiptui, Vector Control Focal Point, Ministry of Health, Kenya, was unable to attend).
The following individuals also attended the second PSC meeting:

- **Ritha Njau**, NPO-MAL, WHO, Tanzania
- **Marie Lynn Miranda**, Professor, Duke University
- **Irene Kanyi**, Programme Assistant, GEF Coordination, UNEP;
- **Adriane Lesser**, Associate in Research, Duke University.

### 3. Agenda of the Second Meeting of the Project Steering Committee

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>8:30-8:45</td>
<td>Welcome, Introductions and opening remarks</td>
<td>Tanzania</td>
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<td>8:45-9:00</td>
<td>Objectives</td>
<td>Birkinesh</td>
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<td>9:00-10:30</td>
<td>Review of Year 1 Progress and discussion</td>
<td>Kenya, Tanzania, Uganda</td>
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<td>• Country presentation on workshops</td>
<td>Cliff</td>
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<td>• Surveys in the three countries</td>
<td>Randy</td>
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<td>• The MDAST tool</td>
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<td>10:30-11:00</td>
<td>Tea Break</td>
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<td>11:00-12:30</td>
<td>Review of Year 2 Activities and discussion</td>
<td>Kenya, Tanzania, Uganda</td>
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<td></td>
<td>Workshops</td>
<td>Birkinesh</td>
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<td></td>
<td>Administrative and Financial Issues</td>
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<td>12:30-2:00</td>
<td>Lunch</td>
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<td>2:00-2:45</td>
<td>Plans for Stakeholder Workshops Round II (August 2011)</td>
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<td>2:45-3:45</td>
<td>General Discussion</td>
<td>All</td>
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<td>3:45-4:15</td>
<td>Wrap-up</td>
<td>All</td>
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<td>18:00</td>
<td>Closing Dinner</td>
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4. MAIN POINTS OF DISCUSSION

4.1 MEETING OBJECTIVES

The meeting began with a review of the meeting objectives as follows:

- To review progress in Year-1 project implementation;
- To Review Year-2 activities and discussion;
- To Plans for Round II Stakeholder Workshops in the 3 countries (August 2011).

4.2 REVIEW AND DISCUSSION OF YEAR 1 PROGRESS

4.2.1 STAKEHOLDER WORKSHOPS (YEAR 1)

- Towards advancing the first-year work plan for MDAST, a stakeholder workshop was held in each of the three project countries during August 2010.
- Stakeholder workshops were organized by collaborators based in each of the project countries as well as collaborators at Duke University, the University of Pretoria, and the WHO.
- Relevant ministries within government including health, environment and agriculture, as well as representatives of district level governments, where appropriate, were invited to participate in the stakeholder workshops. In addition, participation was sought from other relevant organizations.
- There was a brief presentation and discussion on the workshop in each country, including highlights and strengths as well as advice for organizing the stakeholder workshops in Year 2.
- The workshops in each country succeeded in bringing together representatives from many different sectors involved in malaria control, yielding engaging and productive discussions.
- There was enthusiasm among the Steering Committee regarding the potential of the MDAST tool to deeply engage National Malaria Control Program (NMCP) staff in each of the three countries. The project partners must continue and further develop targeted efforts to engage representatives of the NMCP in each country, while noting the country-specific contexts.
- A detailed account of the outcomes of the stakeholder workshops can be found in the relevant report included in the Annual Progress Report for Year 1.

4.2.2 STAKEHOLDER SURVEY RESULTS

- The stakeholder survey was a sub-activity of MDAST project’s Activity 2, “Conduct country-specific development activities to create initial MDAST for Tanzania, Kenya and Uganda”. Data was collected in August 2010.
According to the project proposal, the survey respondents were drawn from a wide range of stakeholders in project countries selected by the in-country MDAST leaders. The survey targeted individuals in ministries, NGOs, universities and research institutes. The primary sectors represented in the survey were those dealing with health, agriculture and environment issues since some of their actions and policies have important implications for malaria vector control.

There was a brief presentation on preliminary results from the stakeholder surveys conducted in all three project countries in conjunction with the workshops. A number of graphs were shown to summarize key findings on stakeholder perceptions and priorities on malaria control programming in the three project countries. The survey results regarding donor preferences emphasize the need to strengthen national research systems in order to better articulate research priorities and provide the necessary guidance to researchers and decision-makers.

The survey results on likelihood of using a tool like MDAST showed a strong enthusiasm for such a model; the reason why stakeholders did not rate their likelihood of use as high as possible may reflect that the tool was in its stages of inception during the workshop and participants were waiting for more information. Survey results should be interpreted with caution; the results represent respondents’ opinions and may not accurately reflect the reality.

Detailed preliminary results from the stakeholder survey can be found both in the relevant individual country reports, as well as the relevant report on all-country aggregated results contained within the Annual Progress Report for Year 1.

Future analysis will enhance the ability to draw meaningful conclusions and policy implications from the data by applying more in-depth analytical activities by and across countries.

4.2.3 MDAST TOOL PROGRESS

An interactive presentation of the MDAST prototype demonstrated the foundational concepts and currently operational components of the tool as well as provided a platform for discussion on the trajectory of its development.

A number of screenshots displaying components of the MDAST prototype can be found in Appendix 1 of this report.

There were suggestions to add more options, e.g. for pesticides, environmental costs, etc.

“Costs” should incorporate more than the purchase cost (i.e. labor and administrative/management costs), while recognizing that input costs can be controversial.

The tool should be reviewed for infeasible or inapplicable options (e.g., spraying every other year is not done and may confuse users).

It is important for the model to incorporate up-to-date literature and information, e.g. a forthcoming DDT expert review, context-specific studies on the evolution of resistance, etc.
4.3 REVIEW AND DISCUSSION OF YEAR 2 PROGRESS

4.3.1 PLANS FOR MDAST TOOL DEVELOPMENT

- It is important for the Steering Committee to be able to view and give input on the tool in advance of the second round of workshops, initially scheduled to take place in August 2011.
- The Steering Committee talked about ways to improve communications and to continue the discussions on model development among all project collaborators in an engaging and dynamic way.
- One suggestion was to conduct webinars, although the logistical complexities of doing this in in-country contexts must be taken into account. A potentially more feasible method would be to share updates of the prototype by emailing progressive screenshots to the Steering Committee and other parties involved in the tool’s development at this stage.
- It was agreed that the input of NMCP staff would be invaluable to the further development and improvement of the tool in advance of the next round of stakeholder workshops. After further discussion, the steering committee agreed that one-on-one tool consultation sessions with key collaborators, particularly with NMCP staff, should take place in August 2011 (with the stakeholder workshops planned for August 2011 to be shifted to April of 2012).

4.3.2 SECOND STAKEHOLDER WORKSHOPS

- Objectives and Expected Outcomes:
  - The objectives of the stakeholder workshops in year two is to update key stakeholders on the status of the project and continue to engage them in its development.
  - In particular, the workshops will serve as a platform for introducing the most current MDAST prototype to the stakeholders and allowing them to pilot the tool themselves through feeding it context-specific information. The goal is for the end users to test the tool and give further feedback on areas for improvement.
  - It was suggested that in addition to the tool, the stakeholders should also be able to evaluate a draft user’s manual.
  - The expected outcomes of the workshop beyond refining the tool itself include: 1) Heightening the interest in the tool among the NMCP in each country, 2) Increase awareness among decision makers and participants concerning consequences of different strategies in malaria control, 3) That the tool be viewed as practical.

- Participants:
  - In terms of numbers, the size of the workshops last year was manageable – each workshop was broken down into four appropriately-sized groups. There were 22-25 people at each workshop last year, and the aim is to keep the number of participants per workshop to under 30.
  - It would be ideal to have continuity and be able to follow-up with last year’s participants.
  - It could be a good idea to issue a courtesy invitation to key politicians and WHO staff as it presents an opportunity to keep them abreast of project developments as
well as inspire confidence among the other stakeholders. However, the potentially sensitive politics in each context must be taken into account when planning.

- Planning:
  - The workshops should be back-to-back to ensure consistency in the methods used and to simplify logistics for those coming from afar.
  - The suggested duration of the workshops is 1.5 days.
  - Before settling on dates, the local WHO offices should be consulted to make sure they are not having a major activity at that time as well.
  - In order to allow additional time to conduct and incorporate input from in-country one-on-one tool consultation sessions with key collaborators (particularly from the NMCP) in August 2011, it was discussed that the stakeholder workshops should take place in April of 2012 instead of in August 2011.

### 4.3.3 ADMINISTRATIVE AND FINANCIAL

- The carry-over of project funds to shift the Year 2 workshops to April 2012 was deemed feasible.
- The Steering Committee agreed on the importance of using necessary mechanisms for streamlining disbursement of Year 2 and Year 3 funding to project partners.
- The Steering Committee discussed planning for the upcoming Midterm Review. There is funding for one reviewer, and the process for selecting that person should start immediately. Ideally, the reviewer should attend the August 2011 consultation sessions with NMCP staff as an observer, in order for him/her to have a first-hand experience of the MDAST project’s collaborative and interactive process.
- SC Members, particularly Duke and Pretoria partners, are to identify the reviewer in consultation with WHO-AFRO. The reviewer will preferably be from the (eastern) African region in order to be able to cover his/her costs within the available budget.

### 4.4 SCHEDULE OF KEY EVENTS 2011-2012

- June 2011: Steering Committee Teleconference
- August 2011: MDAST Tool Consultation Sessions with NMCP Staff; also attended by the project’s mid-term reviewer
- December 2011: Steering Committee Teleconference
- March 2012: Third Steering Committee Meeting
- April 2012: In-country Stakeholder Workshops
APPENDIX 1: SCREENSHOTS OF THE MDAST PROTOTYPE

Diagram 1.1: Prototype MDAST – MDAST User Interface

Diagram 1.2: Prototype MDAST – Human Health Impacts
Diagram 1.3: Prototype MDAST – Program Cost Impacts
REPORT ON THE IN-COUNTRY EXPERT CONSULTATIONS

AUGUST 2011

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INTRODUCTION

BACKGROUND

The aim of the Malaria Decision Analysis Support Tool (MDAST) project is to promote evidence-based, multi-sectoral malaria control policymaking in Kenya, Tanzania, and Uganda, serving as pilot for other malaria-prone countries. The project employs a comprehensive framework to assess the full range of health, social, and environmental risks and benefits associated with alternative malaria control strategies. These project activities are carried out in partnership by collaborators based in each of the project countries (at the Ministry of Health in Uganda, the Ministry of Health in Kenya, and the National Institute of Medical Research in Tanzania) as well as collaborators at Duke University and the University of Pretoria. The project has been developed in a collaborative manner with multiple stakeholders involved in malaria control policy making and implementation. It responds to a need for capacity building for improved policy formulation in malaria control.

PAST STAKEHOLDER ENGAGEMENT ACTIVITIES

To accomplish these goals, it is important to engage a wide range of stakeholders in the project countries through interviews, surveys and workshops. The MDAST project has incorporated stakeholder involvement into the various stages of its development through a range of activities. A project inception workshop and the first steering committee meeting were held in Nairobi in March 2010. In August of 2011, stakeholder workshops were held in each of the three participant countries. The objectives for holding the workshops were to: 1) familiarize key stakeholders with the MDAST project and its objectives; and 2) collect inputs on malaria control decision-making from key stakeholders. During the workshops, representatives from relevant government ministries, district level government entities, and other organizations shared valuable information on the policy environment and research agenda for malaria control as well as their specific input on the MDAST model. Also in August 2011, a survey was administered to key stakeholders to assess their knowledge, perceptions, and preferences. Analysis of the survey results has greatly informed the country-specific development activities for the initial MDAST.

OBJECTIVES OF THE AUGUST 2011 IN-COUNTRY EXPERT CONSULTATIONS

This report details the activities, feedback, and findings of the in-country expert consultations held in all three project countries in August 2011. The primary objectives of the expert consultations were to:

- Familiarize users and potential users with MDAST
- Elicit potential modifications or additions to MDAST
- Identify areas of weakness within MDAST
Malaria Decision Analysis Support Tool (MDAST): Evaluating Health, Social And Environmental Impacts And Policy Tradeoffs

Progress Report: January 1 – November 30, 2011

- Refine the strategy for full dissemination and implementation of MDAST
- Identify mechanisms for MDAST to engender intersectoral collaborations

PARTICIPATION IN AND STRUCTURE OF THE EXPERT CONSULTATIONS

In order to accomplish the stated objectives, a team of primary MDAST project researchers closely involved with the development of the model and previous stakeholder engagement activities arranged to meet with key expert stakeholders involved in the National Malaria Control Program (NMCP) and/or other important malaria control entities in their respective home countries. The list of participants at each consultation and information on their affiliations can be found in Appendix 1. The MDAST researchers involved in all of the consultations included the investigators Randall Kramer (Principal Investigator, Duke University), Clifford Mutero (Principal Investigator, University of Pretoria), Marie Lynn Miranda (Co-principal Investigator, Duke University), and Zack Brown Brown (Research Scholar, Duke University). In addition, each consultation was organized and attended by the in-country project partner, namely Rebecca Kiptui, Edridah Tukahebwa Muheki, and Leonard Mboera in Kenya, Uganda, and Tanzania, respectively.

Each consultation session followed a semi-structured format which included the following components:

1. A presentation of the MDAST model in real-time, which included explanations and demonstrations of its purpose, capabilities, examples of its use, and plans for future development;
2. An interactive, hands-on demonstration of MDAST during which participants engaged in selecting model parameters for a range of alternative policy scenarios and generated a variety of model results;
3. A discussion session during which MDAST researchers elicited feedback from the expert stakeholders, including through standardized discussion questions;
4. A time allotted for individual written feedback according to standardized instruments, including:
   a. Consultation feedback survey, which was administered to all participants to elicit comments on the consultation session and MDAST in general, and
   b. Environmental module questionnaire, which was administered to select participants to gain additional stakeholder input on prioritization of impacts to include in development of the environmental module.

Select parameter selections and results for the interactive demonstrations conducted in the Uganda consultation session are included as an example in Appendix 2. The questions informing the discussion session, consultation feedback survey, and environmental module questionnaire can be found in Appendix 3.

The remainder of this report details the proceedings of the consultation session in each country, including specific feedback on the model from the expert stakeholder participants. These meeting
summaries are followed by an overall conclusion on the expert consultations, followed by the Appendices, which include the list of participants, parameter selections, and instruments used in eliciting formal stakeholder feedback as mentioned above.

**EXPERT CONSULTATION IN KENYA**

The expert consultation with key stakeholders in Kenya was held in Nairobi at the Division of Malaria Control (DOMC) boardroom on the morning of Friday, August 5, 2011. The first of the expert consultations, this session brought together a small group of malaria control experts that gave rich input on the model, its presentation, and its development. The list of stakeholder participants is contained in Appendix 1.A of this report.

**STAKEHOLDER FEEDBACK**

The participants had a number of insightful comments and suggestions at the conclusion of the presentation. The MDAST team gained the following feedback from the discussion:

- A preference was expressed for program costs to be reflected on a per-household basis in addition to the existing metrics.

- The Vector Control section, which includes user-defined parameters for LLINs, IRS, and larviciding, could also include parameters on environmental management activities for vector control (e.g., filling up holes, unblocking drains, etc.).

- There was a detailed discussion on how malaria case management is incorporated into the model, in particular with regards to severe cases. The discussion included a comparison of treatment for uncomplicated cases (i.e., with ACTs) versus treatment for severe cases of malaria. The relative use, benefit, and side effects of using quinine or artesunate via IV for severe cases was brought up. Differential case management for pregnant women was also discussed. It was discussed that the most up-to-date WHO guidelines should be referenced.

- The group addressed the issue of clinician compliance with RDT results, noting that some clinicians will still administer ACT or SP to a patient with a negative RDT result. It was suggested that the reasons for this include that not all clinicians trust the lab results, and that some clinicians may feel that they must give patient some medicine. The importance of addressing the issue of over-prescription of ACTs was discussed (including its impact on resistance) – to increase compliance with RDT results, both health workers and patients should be educated on the purpose and proper use of ACTs and RDTs.

- The visual representation of probabilities and policies in the model can be confusing to the new user (e.g., how output switches between mean levels and probabilities, and the bar graph output representing uncertainty). This indicates we need to consider how the model output can be made clearer so that it can be readily interpreted and understood by new users.
Rebecca Kiptui led the hands-on demonstration of the tool, inputting parameter selections made by other consultation participants to generate output comparing results across three alternative policy scenarios relative to a status quo scenario.

CONCLUSIONS FROM THE EXPERT CONSULTATION IN KENYA

The expert consultation in Kenya provided numerous valuable insights as noted in the preceding section. The session participants also provided useful feedback on improving the clarity of model output so that it can be easily interpreted by new users. Rebecca Kiptui led a successful demonstration of the tool using colleagues’ suggested inputs, which raised interest in and understanding of the tool’s functionality. There was enthusiasm for the tool, with particular appreciation for its emphasis on evidence-based decision making and its capacity to be a useful tool for planning.

EXPERT CONSULTATION IN UGANDA

The expert consultation with key stakeholders in Uganda was held in Kampala at the Vector Control Division Buganda Road Conference Hall on the morning of Monday, August 8, 2011. The majority of the participants in this session (six out of eight participants) had also attended the 2010 Stakeholder Workshops, and were thus both well-acquainted with the project’s objectives and uniquely positioned to give feedback on the evolution of the tool’s development. Among the experts that had previously attended the 2010 Stakeholder Workshop was Edridah Tukahebwa Muheki, Acting Head of the Vector Control Division, who has newly assumed the role of in-country partner on the MDAST project. The list of stakeholder participants is contained in Appendix 1.B of this report.

STAKEHOLDER FEEDBACK

• The participants brought attention to the default values of the Status Quo policy scenario, including asking why the status quo is priced at zero as the default. It was explained that the parameters in the status quo can be edited to reflect the user’s context. However, since determining parameter estimates can be difficult and/or take the user a significant amount of time, these questions underscored the need to present realistic or likely estimates as defaults.

• It was commented that the VCD was interested in having a policy reserving pyrethroids for use in treated nets (i.e., not for IRS) due to concerns about the development of vector resistance. Therefore, he noted that they would like to see additional insecticide alternatives incorporated into the model.
• One participant asked what input MDAST researchers have received on the model so far. The MDAST team mentioned some of the various stakeholder engagement activities that have been conducted and that are planned in the future.

• It was brought up that SP should not be a treatment option, as it should only be used for IPT.

• A participant asked about the incorporation of politics into the model. This was then discussed, in particular the development of a matrix to identify barriers and incentives to implementing optimal policies.

• Seraphine Adibaku, Program Manager of the Malaria Control Program, led the participants in parameter selection during the interactive model demonstration. Specific comments from various participants included:
  o Parameters for nets should reflect coverage and use, not just subsidy rates. It was noted that the utility of subsidy rates might be less currently given free mass distribution campaigns underway.
  o It would be helpful if the model could include other pesticide alternatives (e.g. carbonate, organophosphates) which the MCP plans to rotate.
  o The RDT and microscopy coverage rates were roughly just 17% in a 2009 survey. A copy of the report was requested by the MDAST team.
  o On ACT coverage, it was commented that:
    ▪ Due to stock-outs, the level of coverage for those testing positive is roughly 70%
    ▪ For those testing negative, the coverage is approximately 60%.

• Example parameter selections and selected output for the interactive model demonstration can be reviewed in Appendix 2.A.

CONCLUSIONS FROM THE EXPERT CONSULTATION IN UGANDA

The concluding remarks from the expert consultation in Uganda were informed by observations and suggestions from the model demonstration. The concluding remarks included a discussion on completeness of the model. The stakeholders were curious to know the extent to which MDAST can make predictions or generate output on what might happen with regards to resistance. It was also stated that mass treatment is an important aspect to be considered.

The consultation ended on a positive note, with participants expressing interest in remaining engaged in the MDAST project. It was commented that the MDAST team had generated a lot of interest in the model as a promising tool.
EXPERT CONSULTATION IN TANZANIA

The expert consultation with key stakeholders in Tanzania was held in Dar es Salaam at the National Institute for Medical Research on the morning of Friday, August 12, 2011. The consultation session in Tanzania was comprised of more participants than in the consultations in Kenya and Uganda, which resulted in more of a seminar-format session. The large number of participants engaged in the Tanzania consultation spanned a range of backgrounds and levels of expertise, which generated lively and varied feedback. The list of stakeholder participants is contained in Appendix 1.C of this report.

STAKEHOLDER FEEDBACK

Some of the comments made during the presentation and interactive demonstration session are below.

- Net parameter options should include both subsidy and coverage rates.
- There was a lot of debate about the parameters that should be included for spraying.
- There was discussion on including both the public and private sector activities. For example, one participant wanted to know whether the RDT coverage and outcome parameters included both the public and private sector. This was a helpful discussion for the MDAST team, as it showed the need to clarify this distinction where relevant.
- The group preferred the inclusion of an indicator of burden in the model, e.g. the number of lives saved.
- There was interest in whether a vaccine could be incorporated into the model in the future.
- The issue of compliance with treatment was raised; the provision of ACTs does not necessarily mean they will be used (properly).
- One participant asked whether MDAST could be linked to Health Management Information Systems (HMIS) in Tanzania. It was explained that this is an eventual possibility.
- The following points and questions were also raised:
  - How is resistance incorporated into the model?
  - How does the model deal with the issue of misdiagnosis?
  - LLIN parameters should include both coverage and usage, since those rates are different.
  - The model should consider how to incorporate climate parameters.
CONCLUSIONS FROM THE EXPERT CONSULTATION IN TANZANIA

The consultation session in Tanzania included a large number of participants from a range of backgrounds which contributed to a lively and inquisitive atmosphere. Participants shared comments on specific parameters to consider, including with regards to LLINs, IRS, and climate. Participants also expressed preferences for additions to the model, including clarifying the distinction between the public and private sector, further development of the resistance module, and the inclusion of an indicator of burden; these comments were valued highly in developing priorities for future model development. Finally, some participants were eager to look towards future possibilities for MDAST, asking about the ability to incorporate vaccines into the model and raising the idea of linking it to the Health Management Information Systems (HMIS) in Tanzania.

OVERALL CONCLUSIONS ON THE EXPERT CONSULTATIONS

- A recurring concern in all three countries was healthcare practices. Experts raised the issue of improper use of ACTs by clinicians administering the drugs to misdiagnosed patients or patients with negative RDT results because of a lack of trust in the tests, and suggested the representation of this issue in the model.

- The issue of both insecticide and drug resistance was frequently raised during the consultations. This was reflected in the Environmental Module Questionnaire where insecticide resistance consistently received one of the highest importance ratings across all three countries (Figure 6).

- Another common recommendation was the expansion of insecticidal net parameter options to reflect coverage and use rates. This module is currently being refined.

- With reference to the financial parameters, addition of per-household costs and attention to realistic status quo pricing were suggested.

- Other requests for additions included climate parameters, environmental management activities and an indicator of burden. An interest in the incorporation of vaccines was expressed; however, this received one of the lowest importance ratings in the Environmental Module Questionnaire across all countries (Figure 6).

- Regarding the user-friendliness of the tool, a key suggestion was to make a clearer representation of the probabilities and uncertainties in the model output.
Stakeholders found MDAST to be a useful tool for participatory and multi-sectoral identification of research gaps that countries need to urgently address in relation to malaria epidemiology and control.

### EXPERT CONSULTATION SURVEY FEEDBACK

#### CONTEXT

At the end of the expert consultation session in each project country, time was allotted for individual written feedback according to two standardized instruments: 1) a consultation feedback survey, which was administered to all participants to elicit comments on the consultation session and MDAST in general, and 2) an environmental module questionnaire, which was administered to select participants to gain additional stakeholder input on prioritization of impacts to include in development of the environmental module. Generally, the response format for both surveys was either a 5-point Likert scale or a write-in free response. The write-in qualitative responses elicited in both surveys, which are not included in detail here, are valuable and rich forms of feedback to be actively considered in the further development of the tool. The entry and display of the survey data was done in Microsoft Excel.

The total sample size for each survey and in each project country was as follows:

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It should be noted that the sample size varies slightly for each item, as occasionally a participant did not provide a response to a particular question or sub-question. Of particular note with regards to the Evaluation and Feedback on the MDAST Consultation Survey is that the number of respondents from Tanzania was very high relative to the respondents from the other countries; this must be taken into consideration when assessing the aggregate average across all countries, as obviously the respondents from Tanzania dominate the all-country average. This is due to the large number of participants in the expert consultation session in Tanzania. The environmental module questionnaire achieved a better balance of respondents across project countries, but in this case it must be noted that the sample size was very small since the environmental module questionnaire was only administered to select participants with relevant background and interest. While the sample sizes limit the ability to conduct
extensive statistical analysis, the following summary demonstrates the usefulness of the data collected, both for informing and validating revisions to the MDAST model and approach.

**EVALUATION AND FEEDBACK ON MDAST CONSULTATION SURVEY**

**DESCRIPTION**

The survey given to the stakeholders for feedback on the expert consultation included questions evaluating their understanding, interest, and opinion on the value of MDAST; features or output they would like refined in the tool; how to increase the usefulness and usability of the tool; the level of priority for incorporating potential future features into the model; the level of priority for allowing the user to provide statistical information on uncertainty; and how critical they considered potential barriers to the implementation of MDAST for decision making. The survey instrument itself can be found in Appendix 3.A.

**PRIORITY FOR INCORPORATION OF ADDITIONAL MODEL FEATURES**

Figure 1 shows the average responses in the section of the survey evaluating the level of priority for incorporation of features into the model in the future. The three features receiving the highest average aggregate rating across all three countries were behaviour models of LLIN acquisition, use and disposal; behavior models of treatment-seeking; and demographic targeting of interventions. This was very useful input for the modeling team, which has already begun to respond to this feedback (see, for example, the section on LLIN module development in the “Report on Key Model Developments in Year 2 (2011): Incorporating Stakeholder Feedback”, contained within the Progress Report on page 56).

The inclusion of vaccines, mass drug administration, and genetically modified mosquitoes were ranked as lower priorities (aggregate average across all countries). This could be due to the perception that these strategies are not likely to be viable in the near future. However, recent research and interest during the expert consultation session in Tanzania about the possibility of incorporating vaccines into the model suggest that vaccines may become a higher priority in the future. This suggests the value of occasionally reassessing stakeholder priorities so that MDAST may remain a current and applicable resource for decision-makers. Moving forward, the MDAST website is seen as a future forum for eliciting user feedback on evolving strategies and priorities in the future.
BARRIERS TO FULL IMPLEMENTATION OR DISSEMINATION OF MDAST

Expert consultation participants were asked about their perceptions on how critical various barriers are to the implementation and/or dissemination of MDAST for decision making (Figure 2). Interestingly, the aggregate average across all countries for all potential barriers rated below 4 on the Likert scale, suggesting that on average participants did not perceive the issues as very critical barriers to the success of MDAST. The barrier that received the highest aggregate average (near 4 on the Likert scale) was “applicability to real life”, followed by “acceptance by superiors” and “limitations of relevant scientific research / data”. Respondents from Kenya showed on average a greater concern than the aggregate mean over a number of potential barriers, including acceptance by superiors, applicability to real life, donor preferences, the cost of implementing alternative strategies, and popular pressure / opinion. However, it is important to remember the small sample size when considering the extent to which these data can be used to make inferences at the country level.
Figure 2: Please indicate how critical each of the following BARRIERS is to full implementation (or dissemination) of the tool for decision making?

1= Less Critical, 5 = Very Critical
INTEREST IN AND USEFULNESS OF MDAST

When queried on their interest in and perceived usefulness of MDAST and the consultation, all three countries responded positively about the usefulness of the consultation and the usefulness of the tool, with all averaged responses above 4 on a 5-point scale (for both the aggregate average and the average for each country) (See figure 3, below). The average response in each country indicated agreement that the consultation improved their understanding of MDAST and increased their interest in using MDAST. The average response in each country indicated that they would be likely (or very likely) to use a tool like MDAST, and that they thought policymakers in their country would find MDAST useful. These are encouraging results that highlight the promise of MDAST and the success of the expert consultation sessions in engaging key policy-makers and potential users of the tool in the future.

Figure 3: Rating of the interest in and usefulness of MDAST

Q1 & Q2: 1= Not at all; 3= somewhat; 5= Very Much
Q3: 1= Not likely at all; 3= somewhat; 5= Very likely
Q4: 1=Not useful at all; 3 = somewhat; 5 = Very useful
EVALUATION AND FEEDBACK ON ENVIRONMENTAL MODULE QUESTIONNAIRE

DESCRIPTION

The environmental survey included questions to rate the seriousness of the environmental impact of malaria control activities and the importance of potential environmental impacts. The questionnaire also asked the expert consultation participants to express which environmental indicators they would find useful in future versions of MDAST. A space was also provided to record free-response comments on MDAST and the environmental aspects of malaria control. The actual survey instrument can be found in Appendix 3.B.

ENVIRONMENTAL IMPACTS OF MALARIA CONTROL ACTIVITIES: HOW SERIOUS ARE THEY?

Respondents were asked, “How serious are the environmental impacts of the following malaria control activities?”, followed by a list of 6 options plus the opportunity for respondents to write-in a control activity of environmental concern under the heading of “other”. Entries entered under the heading of “other” are not reported on here but are being considered in the further model development. Figure 4 below shows the results of each country and the aggregate average across all countries.

![Figure 4: How serious are the environmental impacts of the following malaria control activities?](image-url)
The environmental impacts of malaria control activities of larviciding with Bacillus thuringiensis and Indoor Residual Spraying with pyrethroids were ranked as the least serious, suggesting that respondents generally consider these vector control activities relatively safe for the environment. Of those listed, the malaria control activity with the environmental impacts considered most serious was ITN disposal, which rated above 4 on the Likert scale. According to this feedback, this concern is being actively addressed in current model developments, including seeking further input from experts on how to model this issue (see the “Report on Key Model Developments in Year 2 (2011): Incorporating Stakeholder Feedback” in the Year 2 Progress Report). On average across all countries, respondents also thought that the environmental impacts of ITN misuse and IRS with DDT were serious. The environmental impacts of IRS with DDT was considered “Very Serious” by respondents in Kenya and Tanzania, but less so among respondents from Uganda.

**ENVIRONMENTAL IMPACTS: WHICH ARE THE MOST IMPORTANT?**

Respondents to the environmental module questionnaire were asked, “Which potential environmental impacts are the most important?”, followed by a list of 7 options plus the opportunity for respondents to write-in an environmental impact of concern under the heading of “other”. Entries entered under the heading of “other” are not reported on here but are being considered in the further model development. Figure 5 below shows the results of each country and the aggregate average across all countries.

On average across all countries, the potential environmental impacts considered most important (rated above “Important” on the Likert scale) were the development of insecticide resistance, the contamination of agriculture, and water source contamination. Respondents in Kenya seemed more concerned on average about a number of environmental impacts, including water source contamination, non-target species impacts, biodiversity loss, and human-environmental health. On the other hand, respondents from Tanzania seemed less concerned than other respondents with regards to a number of potential environmental impacts, including persistent contamination, biodiversity loss, and human-environmental health. This may reflect a belief that the predominant malaria control activities do not pose significant risk of causing these particular environmental impacts. On average, Tanzanian respondents did believe that the environmental risks of the development of insecticide resistance and contamination of agriculture were important. Again, one must consider the small sample size when considering the extent to which country comparisons can be made.
Figure 5: Which potential environmental impacts are the most important?

1 = Not Important; 5 = Very Important
### APPENDIX 1.A: KENYA EXPERT CONSULTATION PARTICIPANT LIST

<table>
<thead>
<tr>
<th>Name</th>
<th>Title / Institution</th>
<th>Contact</th>
<th>Also attended 2010 Workshop</th>
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### APPENDIX 1.B: UGANDA EXPERT CONSULTATION PARTICIPANT LIST

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APPENDIX 1.C: TANZANIA EXPERT CONSULTATION PARTICIPANT LIST

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<th>ORGANIZATION</th>
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APPENDIX 2: SELECT EXPERT CONSULTATION PARAMETER INPUTS AND RESULTS (UGANDA)

VECTOR CONTROL

DISEASE MANAGEMENT

1. RDT COVERAGE

2. MICROSCOPY COVERAGE

3. ACT COVERAGE
SELECT OUTPUT FROM PARAMETER SELECTIONS (UGANDA)

COMPARISON OF PROGRAM COSTS

MONTHLY INCIDENCE – CASES PER 1000 PEOPLE
**DALYS GAINED**

![Graph showing DALYS gained by demographic cohorts and policies](image)

**COST PER DALY**

![Graph showing cost per DALY by policy and demographic cohorts](image)
APPENDIX 3: EXPERT CONSULTATION SURVEY INSTRUMENTS

APPENDIX 3.A: EXPERT CONSULTATION EVALUATION

Evaluation and Feedback on MDAST Consultation
Dar es Salaam, Tanzania - August 2011

Name (Optional): _______________________

1. How much did the consultation improve your understanding of MDAST?
   1  2  3  4  5
   Not at all  Somewhat  Very much
   
   Comments: ___________________________________________________________

2. Did the consultation increase your interest in using MDAST?
   1  2  3  4  5
   Not at all  Somewhat  Very much
   
   Comments: ___________________________________________________________

3. How likely would you be to use a tool like MDAST?
   1  2  3  4  5
   Not likely at all  Neutral  Very likely
   
   Comments: ___________________________________________________________

4. How useful do you think policymakers in Tanzania would find MDAST?
   1  2  3  4  5
   Not useful at all  Neutral  Very useful
   
   Comments: ___________________________________________________________

5. What features or output need to be refined in the tool for you to use and share the results with others?

6. Please share any suggestions you have on what could be done to make the tool more useful and more likely to be used:

   Please continue on next page
7. Please indicate what you think the level of priority should be for incorporating each of the following features into the model in the future:

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<th>Medium</th>
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<tr>
<td>Behavioral model of treatment-seeking</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Model private &amp; public markets for antimalarial drugs</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Seasonal vector recruitment &amp; disease dynamics</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mass Drug Administration (MDA)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Vaccines</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Genetically modified mosquitoes</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Habitat control</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Demographic targeting of interventions (e.g., target IRS to households of a specific composition.)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Other (Please Specify):</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Comments and other desired features:

8. The MDAST platform can allow users to investigate how uncertainty in some of the inputs affects the uncertainty in the tool's output. For the following input parameters, please indicate the level of priority for allowing the user to provide statistical information on uncertainty, such as standard errors or confidence intervals:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Should not be allowed to be uncertain (mark 'X')</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosquito ecology, behavior, and population dynamics</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Human behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Human immunity to malaria</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Intervention impacts</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Comments:

9. Please indicate how critical each of the following barriers is to full implementation (or dissemination) of the tool for decision making?

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Less Critical</th>
<th>Medium</th>
<th>Very Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance by superiors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Uncertainty of outputs</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Applicability to real life</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Technological limitations</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Cost of implementing alternative strategies</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Popular pressure/opinion</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Donor preferences/agenda</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Limitations of relevant scientific research/data</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Other (Please Specify):</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Comments:

10. Would you use an internet-based discussion website to exchange information on MDAST with other policy makers in Tanzania and other countries?  

[Yes] [No]

Comments:

11. Please share any other comments on MDAST and the consultation:
### APPENDIX 3.B: ENVIRONMENTAL MODULE QUESTIONNAIRE

#### MDAST NMCP Consultations, August 2011

Environmental Module Questionnaire Results

MDAST Environmental Module Questionnaire
August 2011

1. How serious are the environmental impacts of the following malaria control activities?

<table>
<thead>
<tr>
<th>Control activity</th>
<th>Not Serious</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITN treatment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>ITN disposal</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>ITN misuse</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>IRS with pyrethroids</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>IRS with DDT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>Larviciding with BT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>Other (Please Specify):</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>X</td>
</tr>
</tbody>
</table>

2. Which potential environmental impacts are the most important?

<table>
<thead>
<tr>
<th>Potential environmental impact</th>
<th>Not important</th>
<th>Very Important</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human-environmental health</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Biodiversity loss</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Non-target species impacts</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Persistent contamination</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Contamination of agriculture</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Development of insecticide resistance</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Water source contamination</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Other (Please Specify):</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
3. Right now, the environmental impacts module in MDAST only provides indicators of how much of each chemical or substance (e.g. DDT or B. thuringiensis) is used in each vector control activity. We have plans to expand this module substantially. Are there any environmental indicators that you would find useful in future versions of MDAST? If so, please list them below, and if possible provide a short explanation of why you would like to see each indicator in MDAST:

   a. Indicator: __________________________ Why include? __________________________

   b. Indicator: __________________________ Why include? __________________________

   c. Indicator: __________________________ Why include? __________________________

   d. Indicator: __________________________ Why include? __________________________

4. Please share any other comments on MDAST and the environmental aspects of malaria control:
SUMMARY & RESPONSE TO THE MID-TERM REVIEW REPORT

TABLE OF CONTENTS: SUMMARY & RESPONSE TO THE MID-TERM REVIEW REPORT

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The summary and response is organized according to the terms of reference activities that were specified for the Mid-Term Review. Responses are indicated by italicized text.

VERIFY THAT THE MDAST PROTOTYPE IS THE PRODUCT OF COUNTRY-SPECIFIC INPUT AND DEVELOPMENT ACTIVITIES.

• Stakeholders from multiple relevant sectors have contributed significantly to the development of MDAST through a variety of mechanisms and activities (workshops, surveys, consultations)
  ▪ Response: We are glad that the reviewer was exposed to a range of the project’s stakeholder engagement activities in the course of his review.
• The latest MDAST consultation conducted at NIMR was attended by 32 stakeholders (13 NMCP staff, 17 researchers, 2 WHO officials). While their exposure to the tool was relatively brief, there was general enthusiasm for the utilization of MDAST. In general, the MDAST activities and prototype have been well-received at the country-level.
  ▪ Response: We are pleased that key participants in the recent expert consultation at NIMR conveyed to Dr. Mbogo the same level of enthusiasm for MDAST that we experienced from them at the consultation itself. While the consultation only
permitted a brief review of the tool, the next round of workshops will include a sessions devoted to training a core group of knowledgeable users of the tool.

- Inputs that have been provided by the NMCP staff will contribute to further tool refinement.
  - Response: This is certainly true. The MDAST Team is in the process of reviewing and incorporating the discussions and formal written feedback from the expert consultations into the tool.

- The two Steering Committee Meetings that have been held have provided an opportunity to review progress and recommendations and have “ensured that all partners are working together and in close collaboration to ensure coordination of the project activities”.

**VERIFY THAT THE MDAST PROTOTYPE IS AT AN OPERABLE STAGE FOR TRAINING ACTIVITIES**

- The provided project documents clearly described and presented the tools. The draft user manual is user-friendly but still under development, as is an anticipated online project site and potential user discussion forum.
  - Response: We are encouraged by the review’s affirmation that the tool and Draft User Manual are user-friendly. We are confident that the forthcoming project website will also be seen as user-friendly and will provide a valuable forum for MDAST users.

**CONFIRM THAT SUFFICIENT PROGRESS HAS BEEN MADE ON THE MDAST PROTOTYPE.**

- Good progress has been made on the project activities (e.g. All Year 1 Activities covering draft MDAST prototype and country-specific development activities completed).
- Considerable progress has been made on the MDAST prototype, which has been demonstrated to stakeholders to gather their feedback through a variety of mechanisms and activities.
- The interview with Dr. Renata Mandika (NMCP) revealed that during the consultation session, issues were raised regarding the content that reflects realistic control choices, parameters, and outputs. Consultation participants suggested the inclusion of additional parameters, e.g. insecticide resistance, drug resistance, outdoor transmission, and community engagement.
  - Response: Future tool development activities will certainly involve the revisions and incorporation of additional parameters. We agree that resistance and community participation parameters are especially important. However,
extensive further developments on outdoor transmission modeling are beyond the scope of the current project.

**IDENTIFY POTENTIAL PROBLEMS AND AREAS FOR IMPROVEMENT.**

- “One of the main potential problems cited is the practicability of the tool in its use of the available data...The greatest challenge is the acquisition of high quality data... there is a need to strengthen capacity for quality data collection”
  - **Response:**
    - There are limits to what MDAST can accomplish with regards to data quality and availability given the scope of the project. Nonetheless, we are considering a number of ways which would address these issues in part:
      - We are discussing how to refine the tool so that it can operate with reasonable defaults if the user cannot provide the contextual data for given parameters.
      - We are continuing to discuss and refine how the model addresses and reports on uncertainty.
      - We will continue to research and revise additional parameters from the literature in the future (including on larviciding from the NIH-Mvomero project).
      - Finally, the aim is that MDAST will increase the value of evidence-based decision-making, thereby increasing the demand for high-quality data in the broader research and policy-making agendas.
  - **Interpretation of results**
    - Key issues need to be addressed in order for interpretation of results to be accurate (e.g. resistance – “the presence of resistance does not mean that the malaria intervention will fail”)
      - **Response:** The feedback we have received from the expert consultations and the mid-term review will be very valuable as the model continues to undergo development and refinement.
    - “Do we have a guide on decision making based on data collected?”
      - **Response:**
        1. Future versions of the User Manual will include greater detail to guide the novice user as to the interpretation of results.
        2. The project activity on barriers and opportunities for implementation of optimal malaria control policies is intended to address how to translate data and model output into policy-
Making at different scales through the development of an incentives matrix and other tools to be integrated into MDAST.

- “What criteria or what threshold should be used?”

**RECOMMEND ISSUES THAT NEED TO BE CONSIDERED IN THE NEXT PHASE OF THE PROJECT FOR ITS SUCCESS.**

- Prototype needs to be completed and peer-reviewed before its use can be adopted.
  - Response: This is part of the planned process for the continued development of the tool.

- There is a need for a SOP for in-country data collection, addressing data completeness, quality, & reliability.
  - Response: The User Manual can address some of these aspects. However, there is a limit to what the project can achieve with respect to data quality and availability (please see additional comments on data quality and availability issues under TOR 4 above).

- In the spirit of an IVM strategy, applicability of MDAST should be expanded to other vector-borne diseases (e.g. LF, HAT, etc.)
  - Response: While we agree that policy-making on other vector-borne diseases (such as LF and HAT) could benefit from a decision analysis approach (and in fact there are other research groups already exploring such avenues), the incorporation of other vector-borne diseases into the MDAST model is beyond the scope of the current project and might detract from our emphasis on malaria control decision making. However, MDAST is committed to incorporating an IVM approach into the project activities where appropriate.

- In order to effectively disseminate and implement the tool, there is a need for training a core group of knowledgeable users who understand its operations and can assist with trouble-shooting, etc.
  - Response: The MDAST Team fully agrees, which is an objective of the next round of in-country stakeholder workshops as well as the forthcoming project website.

- Need to include or re-address particular parameters, e.g. insecticide resistance, drug resistance, community participation, and outdoor transmission. Regarding outdoor transmission, the inclusion of environmental management is there, but more should be explored.
  - Response:
    1. Future tool development activities will involve the revisions and incorporation of some additional parameters.
    2. We agree that resistance and community participation parameters are especially important. Insecticide resistance is still undergoing refinement
in the model. We are also considering additional parameters to capture community participation and adherence factors in addition to refinements that have already been made.

3. With regards to outdoor transmission, the model includes environmental management activities such as larviciding parameters which will be further expanded moving forward as part of the NIH-Mvomero Project, which is addressing a paucity of data on larviciding. However, extensive further developments on outdoor transmission modeling are beyond the scope of the current project.

- **Institutional arrangements**: In order to have a comprehensive, effective and supportive infrastructure at the central level (NMCP), two major aspects need to be addressed so as to move the MDAST prototype forward; Structure and Linkages. The current management structure of the project lacks a focal operational leadership point with the expertise or the mandate to guide development of the MDAST at the country level, and operational capacity of the support infrastructure. The establishment and collaboration between the national malaria control program and the National Research group should be strengthened in order to maintain and sustain the gains over time for the required technical skills and capacities."
  
  o **Response**:

  1. The project is coordinated at the country-level by the in-country leads and their institutions, and overall by Duke and UoP. All project partners collaborate with NMCP staff to elicit their feedback on the tool, which is the focus of the recent round of expert consultations.
  2. The structure and linkages between key stakeholder entities vary somewhat by project country. In Kenya, the DOMC is directly involved as a project lead organization. There is a new in-country project lead in Uganda who is enthusiastic about the project and involving stakeholder colleagues, including the program manager of the NMCP who attended the recent expert consultation in Kampala and was also supportive.
  3. The project in Tanzania may exhibit fewer linkages than the other project countries because NIMR stands independently from NMCP. There has been a change in leadership at NMCP, but we are confident that we have now been able to effectively engage the new leadership.
  4. Nonetheless, the MDAST Team notes the concern of the reviewer regarding the strength of linkages between key MDAST stakeholder entities in Tanzania. Duke and UoP are committed to working with the in-country partners to ensure greater linkages and ownership with key stakeholders and target users, especially in the NMCP.
In conclusion, the reviewer reiterates the potential value of MDAST as a user-friendly educational and public health policy-making tool to enable optimization of local malaria control strategies in resource-constrained settings.

- **Response:** The MDAST Team is encouraged by the overall positive review of the project activities in Tanzania to-date. The project team regrets that the scope of the review could not also consider the project’s activities and achievements in Kenya and Uganda as it is confident that the implementation of the project in those countries would also have met with a favourable review. Nonetheless, the review has offered valuable feedback to the MDAST Team, particularly regarding the perceptions of the reviewer, NMCP staff, and other key stakeholders. The reviewer’s recommendations will be given full account in the future development of the model as indicated throughout the responses above.
KEY MODEL DEVELOPMENTS IN YEAR 2 (2011): EVALUATING AND INCORPORATING STAKEHOLDER FEEDBACK

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INTRODUCTION

Extensive model developments were made in 2011 to incorporate key stakeholder feedback from a variety of forums, in accordance with Activity 4 (engaging in country-specific training, testing, and refinement activities) as laid out in the Year 2 Work Plan. The rich feedback from key stakeholders to-date has presented many opportunities to further refine the tool according to an enhanced understanding of the situation on the ground as well as the needs of its anticipated users. As evidenced in the summary that follows, the information gained through these varied forms of stakeholder involvement has been essential to the process of appropriately refining the MDAST model so that it can better address the full range of health, social, and environmental risks and benefits associated with alternative malaria control strategies. It is also important to note that the process of gaining and incorporating stakeholder feedback has not only been essential to strengthening the model itself, but has also been instrumental in building understanding and a sense of ownership of the tool among key in-country decision-makers – its targeted users.

KEY STAKEHOLDER ENGAGEMENT ACTIVITIES AND FEEDBACK

The project has actively engaged key stakeholders across a range of sectors and levels in all three project countries in the development of MDAST through a variety of mechanisms including interviews, surveys, workshops, and consultations. The project partners participated in and benefitted from a number of organized stakeholder engagement activities and feedback in Year 2 of the project. These included:

1. The Second Regional Steering Committee Meeting (March, 2011)
2. MDAST webinar consultations with key project partners (April – June, 2011)
3. External review of the MDAST model and development process (June, 2011)
4. Expert consultations with NMCP staff, in-country partners, and other experts (August, 2011)
5. External Mid-Term Evaluation Report and Review (August – September, 2011)
6. Progress Meeting, Geneva (September 2011)
7. Inquiries to in-country partners and NMCP staff on proposed LLIN module developments (November 2011)

With the following exceptions, the above activities are detailed in this report. Detailed reporting on the expert consultations as well as the external review and response can be found elsewhere in the Progress Report for the Period January 1, 2011 – November 30, 2011. The inquiries to in-country partners and NMCP staff on proposed LLIN module developments were made only recently; the results will be reported on after all feedback is received.
TRAINING, EVALUATION, AND REFINEMENT ACTIVITIES LEADING UP TO THE EXPERT CONSULTATIONS

During the project period of January 1, 2011- November 30, 2011, the project partners have engaged in numerous country-specific training, testing, and refinement activities with regards to MDAST, in accordance with Activity 4. In particular, the project partners have carried out the following:

INCORPORATION OF FEEDBACK FROM THE FIRST ROUND OF MDAST STAKEHOLDER WORKSHOPS (JANUARY – FEBRUARY)

In further developing the tool throughout Year Two of the project, the team took into full consideration input from discussions and survey feedback gained during the first round of MDAST Stakeholder Workshops in all three project countries in the first year of tool development. The workshops provided a forum to solicit insights on the tool from a wide range of potential users, including staff of relevant government ministries (e.g., health, environment and agriculture), representatives of district level governments, and other relevant organizations. A summary of the feedback which project partners addressed during the tool’s development in Year Two can be found in the Progress Report for Year One.

DEMOnSTRATION OF PROTOTYPE MDAST DURING THE SECOND MEETING OF THE PROJECT STEERING COMMITTEE (MARCH)

A prototype MDAST incorporating comments from the MDAST Stakeholder Workshop participants was presented at the Second Meeting of the Project Steering Committee on March 10 in Dar es Salaam. Members of the Steering Committee gave valuable feedback on the tool, detailed elsewhere in this report.

IN-DEPTH MDAST WEBINAR CONSULTATIONS WITH KEY PROJECT PARTNERS (APRIL – JUNE)

Throughout the months of April, May, and June, the MDAST model development team conducted webinars on the tool with key in-country project partners for a total of five consultation sessions. In each session, the revised prototype model was presented, along with a series of brief, informative examples demonstrating the capabilities of the tool. Generally, the remote consultations were conducted in real-time through screen-sharing as data were entered into the model and the examples were performed. Where the internet connection did not support this technology, the presentations were conducted using a set of pre-constructed screen-shots of the tool operating in progressive stages, sent via email in advance of the meetings. Each consultation session generated important feedback on the tool, including highlighting areas where modifications would be valuable.
EXTERNAL REVIEW OF THE MDAST MODEL (JUNE)

A review of the MDAST model and its development process was sought from a professor at Duke University with a background in modeling and disease ecology. Dr. Koelle received a copy of the model in advance and was then asked to report her impressions, observations, and suggestions to the developers. As an external reviewer previously unfamiliar with the MDAST model, her fresh, informed perspective generated valuable feedback to take into account during further model development. The external review also offered an important opportunity to consider how to structure the presentation of background information on the tool and to evaluate first impressions of the model, both of which were valuable exercises in preparing to draft the MDAST User Manual.

REVISIONS TO THE MDAST MODEL PRIOR TO THE AUGUST 2011 EXPERT CONSULTATIONS (MARCH – JULY)

The MDAST prototype revised in advance of the August 2011 Expert Consultations reflected continuous efforts to respond to and incorporate feedback gained from the Second Meeting of the Project Steering Committee and the project partner webinar consultations. A major overhaul of the tool was undertaken to reflect advances in the scientific community’s knowledge of malaria transmission and how to model the impacts of many different interventions on reducing malaria burden. This work drew heavily on Griffin, Hollingsworth et al. (2010), but added to this research by incorporating models of emergent insecticide resistance in the IRS and LLIN interventions. A screenshot of the front-end user interface for this prototype is shown below.

Additional revisions were made based on planned development of the model. Changes made to the model since it was presented at the Second Meeting of the Project Steering Committee prior to the August 2011 Expert Consultations include:
• Further development on the underlying model (especially with regards to transmission), as informed by a review of the work of other current modeling groups (especially Griffin, et al., 2010\textsuperscript{1}).

• The functionality to simultaneously run and compare three policy portfolios along with the “status quo” policy scenario,

• Further development of the environmental impacts module, including the ability to track insecticide and larvicide chemical use over time.

• Initial incorporation of uncertainty into the tool, as demonstrated through the mosquito abundance parameter.

• Further development to incorporate costs into the model – the cost per case of malaria avoided is now an output of the tool.

• Aesthetic improvements to give MDAST a cleaner, more contemporary style, including a simplified front-end parameter input section and adapting the top level modules to conform to the newly-designed MDAST color scheme.

DRAFTING OF A PROVISIONAL MDAST USER MANUAL FOR TRAINING PURPOSES (JUNE – JULY)

A provisional MDAST User Manual was developed and referenced at the in-country expert consultation sessions with National Malaria Control Program staff as well as in the Mid-Term Review. This manual is a preliminary working draft for the final User Manual, and will be revised as the model undergoes further modifications and development. The preliminary User Manual is contained in a document separate from this report.

MODEL DEVELOPMENTS CONDUCTED AFTER THE EXPERT CONSULTATIONS (AUGUST – NOVEMBER 2011)

In August 2011, Expert Consultations were conducted in each of the three project countries with MDAST stakeholders including key staff of the National Malaria Control Program (in Kenya, the Division of Malaria Control), in-country partners, and other experts. A primary aim of these consultations was to elicit suggestions for revisions and enhancements to the prototype that would increase usability. In addition to the consultations, a member of the modeling team (Zack Brown) met in September with Dr. Birkinesh Ameneshew to discuss progress and necessary revisions to the prototype tool. The external Mid-Term Evaluation Report and subsequent review among key project partners also informed further tool development.
IDENTIFICATION OF PRIORITIES FOR TOOL DEVELOPMENT

Based on the above feedback, the MDAST modeling team identified the following priority areas for near-term tool development:

- Enhanced options for users to specify a mixture of LLIN distribution modes (e.g. mass distribution, subsidy scheme, or voucher system).

- **Addition of bendiocarb** (an insecticide belonging to the class of carbamates) as an option in IRS programs (in addition to DDT and the pyrethroid class ICON).

- Refinement of the tool components dealing with **insecticide resistance**, accounting for the addition of bendiocarb to the arsenal of IRS insecticides in the tool. This work also includes the addition of an output on the front-end user interface displaying observable insecticide resistance metrics for each policy scenario considered.

- Modification of the disease burden metrics to include more refined calculation of the incidence of **severe disease incidence and malaria-attributable deaths**.

- Development of an intuitive, user-friendly procedure allowing the user to calibrate the contextual parameters of the tool (e.g. endemicity levels, population structure, prior levels of insecticide resistance). Bearing in mind the decision analysis focus of MDAST, this is to **allow the tool to reflect users’ knowledge and beliefs of malaria transmission in their region of concern**.
Malaria Decision Analysis Support Tool (MDAST): Evaluating Health, Social And Environmental Impacts And Policy Tradeoffs

Progress Report: January 1 – November 30, 2011

TIMELINE FOR REVISION OF THE MDAST PROTOTYPE

Based on these development priorities, the following timeline for prototype revision was adopted:

<table>
<thead>
<tr>
<th>Status</th>
<th>Activity</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Done</td>
<td>Add environmental impacts for resistance</td>
<td>September</td>
</tr>
<tr>
<td>Done</td>
<td>Add vector susceptibility outcome measure to resistance output</td>
<td>October</td>
</tr>
<tr>
<td>Done</td>
<td>IRS module refinements:</td>
<td>October</td>
</tr>
<tr>
<td></td>
<td>• Add bendiocarb option</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Update resistance mutations</td>
<td></td>
</tr>
<tr>
<td>In Progress</td>
<td>Develop new LLIN intervention submodule</td>
<td>October</td>
</tr>
<tr>
<td>In Progress</td>
<td>Add in/out flows for net stock</td>
<td>October - November</td>
</tr>
<tr>
<td>Done</td>
<td>Severe disease &amp; deaths submodules</td>
<td>October - December</td>
</tr>
<tr>
<td>In Progress</td>
<td>Refine/correct DALY submodule</td>
<td>November</td>
</tr>
<tr>
<td>In Progress</td>
<td>Economic / program costs for disease management</td>
<td>November</td>
</tr>
<tr>
<td>In Progress</td>
<td>Fill in other missing outputs</td>
<td>November - December</td>
</tr>
<tr>
<td>In Progress</td>
<td>Visual refinement &amp; color coding</td>
<td>November - December</td>
</tr>
<tr>
<td>Future</td>
<td>Allow refined model to compare alternative policies</td>
<td>December</td>
</tr>
<tr>
<td>Future</td>
<td>Develop and implement model calibration procedure</td>
<td>January – February</td>
</tr>
</tbody>
</table>

The developments in the above table that have been completed or nearly completed are summarized individually below.

ADDITIONS AND REVISIONS TO THE MODEL

INDOOR RESIDUAL SPRAYING AND INSECTICIDE RESISTANCE

As noted in the above table, the modeling team has completed the incorporation of bendiocarb as an IRS option, along with associated updates to the insecticide resistance module. Necessary parameters for accounting for this insecticide in IRS consisted primarily of information on how long the effects of bendiocarb last when applied via IRS, as well as estimates of the per household costs bendiocarb-based
IRS programs (Maharaj, Casimiro et al. 2004; Sadasivaiah, Tozan et al. 2007; Akogbeto, Padonou et al. 2010).

Critically, this update captures the tradeoff expressed by WHO and a number of stakeholders between near-term costs associated with a more expensive insecticide, such as bendiocarb, and improved sustainability of IRS using bendiocarb, due to slower emergence of resistance. This work involved permitting 3 different insecticide resistance mutations to evolve simultaneously in modeled Anopheles populations. One of these mutations—a knockdown resistance (kdr) mutation—causes resistance to DDT and pyrethroids (Reimer, Fondjo et al. 2008; Djogbénou, Noel et al. 2010). Another mutation — known as P450—causes resistance to pyrethroids only. Finally, the G119S mutation causes resistance to bendiocarb (Nauen, 2007). Standard mathematical equations for gene selection were utilized to model spread of the mutations (Nowak, 2006).

Whether or not resistance becomes a concern for any given LLIN and/or IRS program depends on 9 parameters, 3 for each of the 3 mutations:

a. The initial level of insecticide resistance at the beginning of a policy scenario for each of the 3 insecticides modeled in the tool. This is most closely comparable to the standard bottle assay test for vector susceptibility to a given insecticide (Zamora Perea, Balta Leon et al. 2009).

b. The speed over which evolution occurs, given a particular vector control profile.

c. The maximum level of insecticide usage (in both LLINs and IRS) that can occur before selecting for insecticide resistance in the long-run.

In the completed version of the tool, these parameters will be calibrated by the user, depending on her knowledge and beliefs about the potential impediments arising from insecticide resistance. It is important to note that the insecticide resistance also factors in the potential for problems to arise with resistance to LLINs. Thus, this module is ready for connection with the LLIN acquisition, use, and disposal module currently under development (see below).

MEASURING THE BURDEN OF MALARIA: MORBIDITY AND MORTALITY

In addition, work has been completed on updating the measure of disease burden, in particular through the use of a metric for incidence of “severe disease” and “malaria-attributable deaths.” The basic intuition for this module is as follows: The longer an individual’s malaria symptoms last the more likely their illness is to transition to a severe case. Subsequently, the longer a severe case lasts, the more likely that individual is to die as a result of their illness. Vector control limits the incidence of severe cases by reducing or interrupting disease transmission, thus limiting the recruitment of additional patent cases which may become severe. Drug therapy (and prompt and effective healthcare more generally) limits incidence of severe cases by limiting the expected duration of illness, thus limiting the likelihood that a symptomatic case becomes severe illness. Work is still being done to ascertain reasonable numbers for the hazard rate at which symptomatic cases transition to severe illnesses, as well as the
hazard rate of death conditional on having severe malaria (e.g. Lubell, Reyburn et al. 2008). These parameters can be calibrated by the user, depending on the level of detail in their health clinic data.

### LLIN ACQUISITION, USE, & DISPOSAL

#### BACKGROUND

Feedback from both the expert consultation sessions and the Mid-Term Review advised that the LLIN module of the current MDAST model should be refined, including to allow for multiple distribution systems and flows of ownership/usage dynamics and expiration of LLINs. The LLIN acquisition was modeled based on static demand and thus it needed some estimates of households’ take-up rates over time in their LLIN purchasing decisions and usage behaviors due to different net distribution, education intervention, and disposal strategies. In further developing the module, the team has performed three key tasks:

1. Systematic literature review on LLIN distribution in East Africa
2. Consultation with experts and in-country leads on proposed LLIN developments
3. Development of refined LLIN module of the prototype MDAST model

#### SYSTEMATIC LITERATURE REVIEW ON LLIN

A systematic survey of literature (n=20) on Long Lasting Insecticidal Net (LLIN) distribution schemes in East Africa and their relationship with LLIN use rates, coverage rates, and malaria outcomes was conducted. Factors impacting use rates such as concurrent educational programs and subsidy rates were also documented. The publications were based in the East African countries of Tanzania, Kenya, Uganda, Ethiopia, and Zanzibar; nearby countries, Rwanda, Mozambique and Madagascar were also included.

A majority of the studies (17) were one-time surveys conducted a few months to 15 months following a mass distribution of LLINs. Only 3 studies were conducted over a period of years, revealing a lack of data on the impact of re-distribution and follow-up education on usage and coverage rates in a population. 11 of the studies conducted baseline surveys prior to the distribution of the LLINs. Of the four studies that surveyed the malaria outcomes, three found statistically significant reduction in prevalence or parasitemia rates associated with LLIN distribution campaigns.

Distribution strategies were either based on target demographics or specific channels and subsidies. LLINs were distributed in campaigns with partially subsidized rates, as redeemable vouchers at antenatal clinics, or entirely free as a mass distribution. Due to overwhelming variation in study conditions, it is not feasible to quantify the differences in the impacts of various distribution types on coverage and usage rates. Noor et al (2007) found that free distribution was the most effective method to rapidly scale up net coverage in rural areas, which is supported by De Oliveira et al (2010) who found that voucher-based distribution of nets might achieve lower coverage rates than direct distribution of free nets because of the extra step involved with vouchers. Ahmed and Zerihun (2010) reported that subsidized distribution
appeared inadequate and inequitable, and support the free distribution of nets to achieve necessary coverage and use rates. Kolaczinski et al (2010) concluded that both targeted campaigns and routine distribution with ante-natal clinic services can achieve high LLIN retention and use in a target population, however the costs association with ANC distribution are relatively higher because it is a newer distribution channel.

The demographic groups targeted were, children under 5, pregnant women, or general populations in malarious areas. A majority of the campaigns targeted children under 5 at least in part. With declining transmission, it is expected that the burden of malaria will shift to older age groups and future net campaigns may therefore need to target older children with school-based distribution as a possible approach (Githinji et al 2010). Several studies noted that concurrent education campaigns were required to inform net users that children should sleep under nets as a priority over adults. The reviewed articles universally suggested that addressing community-specific practices and attitudes through targeted educational campaigns promotes consistent and correct use of the distributed nets.

All surveys demonstrated some degree of increase in coverage and usage rates following distribution. Results were as dramatic as an increase in usage from 0 to 89.4% 15 months after distribution and education (Widmar et al 2009) or a more modest increase in coverage from 36.7% to 56.7% one year after distribution (Ngondi et al 2011).

Shargie et al (2008) offer some possible factors for declining use rates after a peak following a distribution campaign. Fewer malaria cases due to widespread LLIN use may cause a reduced perception of the risk of malaria and thus a decrease in net usage. Second, nets that became damaged were considered useless and deemed unfit for repair. Githinji et al (2010) found 40% of inspected nets were damaged within less than one year since distribution. The study indicates that “the physical quality and resilience of nets used in poor rural settings, may not last the three years planned in the government strategy, let alone the five years lifespan of the currently promoted long lasting insecticide treated nets.”

CONSULTATION WITH IN-COUNTRY EXPERTS

The team has solicited feedback on the proposed LLIN refinements from in-country partners and National Malaria Control Program staff (Division of Malaria Control in Kenya) on the following questions and the LLIN Module Flowchart on the following page:

(1) The proposed LLIN module includes three strategies of LLIN distribution (large-scale mass distribution, clinic-based distribution, voucher distribution through retail sector). Would you drop any of them or add any other distribution strategy?

(2) Regarding each LLIN distribution strategy, the module includes "duration of distribution", "targeted coverage", and "subsidy rate" as actual decision parameters for users to choose. Would you drop any of them or add any other decision factors?
(3) The proposed LLIN module includes "educational activities and communications" which could influence the LLIN ownership or use rates over time. What other factors do you think impact LLIN ownership or use rates and how?

(4) The proposed LLIN model includes three possible strategies for LLIN disposal (recycling, waste disposal, do nothing). Would you drop any of them or add any other disposal strategy?

(5) The proposed LLIN module includes "educational activities and communications" which could influence the LLIN disposal dynamics over time. What other factors do you think will impact LLIN disposal dynamics and how?

The inquiries to in-country partners and NMCP staff on proposed LLIN module developments were made only recently; the results will be reported on after all feedback is received. Nonetheless, initial feedback has already led to further refinements of the MDAST model.

**LLIN Module Flowchart**

ANALYTICA MODELING ON LLIN MODULE

Based on the literature review and expert consultation, the team has begun to refine the LLIN module of the MDAST model. As illustrated in Figure 1, the LLIN module should include two decision variables; (1) LLIN distribution strategies with three options (large-scale, clinic-based, and social marketing), (2) LLIN...
disposal strategies with three options (waste disposal, net recycling, and do nothing). The LLIN distribution decision factors should be associated with four sub-decision factors (subsidy rate, duration and location of distribution, targeted coverage, and frequency of education/communication sessions), while the LLIN disposal decision factors are associated with the existence/scope of management system and/or infrastructure handling net disposal dynamics in each country. These decision variables should estimate the major outputs, net ownership rate (i.e. likelihood of net ownership per person over time) and net use rate (likelihood of correct net use per person over time), combined with various input parameters (malaria burden, demography and economics). These LLIN ownership and use rates should be linked to other modules (projected cost, projected malaria burden, and environmental indicators modules) in determining costs and effectiveness of malaria control through LLIN and the size of any negative environmental impacts.

PRIORITIES FOR FUTURE DEVELOPMENT OF THE MODEL

Once the requested revisions are completed, the modeling team will work to put the tool “back together,” so that multiple policies can be analyzed simultaneously against a status quo set of interventions. The modeling team will then work on a calibration procedure, which will allow users to provide values for the tool’s parameters using real-word, standard measures of malaria transmission—e.g. incidence of severe cases at health clinics, proportion of severe cases in children versus adults, and vector susceptibility to insecticides.

Finally, the modeling team will arrange a series of webinars with our in-country stakeholders and with scientific experts on the MDAST team, to assess the utility and the scientific validity of the revised tool, and to make small refinements where needed, prior to an in-country launch of the tool in April.

REFERENCES


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Activity 3: Identify institutional barriers to implementing optimal policies, as well as incentives for addressing these barriers

3a. Identify barriers to adopting preferred policies at different scales (e.g., national, district-level), and incentives to address these barriers
3b. Identify barriers and incentives for policy implementers to monitor and evaluate policy results

Using the MDAST framework to select optimal malaria interventions will not result in policy or regulatory reform unless existing barriers to implementing these policies are eliminated and appropriate incentives are put into place to activate the new policies and monitor their results.

This activity will use institutional analysis to create an incentives matrix for identifying the barriers to preferred policies that may exist at the national and district level and to ascertain necessary incentives to overcome those barriers. In addition, barriers and incentives related to conducting policy-relevant research and evaluating policy results will be identified so that each round of policy reform can generate additional feedback for future policy deliberations.

INTRODUCTION

Malaria is a complex and pernicious disease caused by a plasmodium parasite and transmitted by mosquitoes, primarily of the genus Anophelus. Globally, there are approximately 225 million cases of malaria each year, resulting in around 781,000 deaths (World Health Organization, 2010). Given the complexity of malaria and thus the complexity of intervention, significant barriers to implementation of optimal malaria policy making exist. Barriers exist in a wide variety of dimensions, including those which are social, financial, cultural, and institutional.

The aim of the Malaria Decision Analysis Support Tool (MDAST) project is to promote evidence-based, multi-sectoral malaria control policymaking in Kenya, Tanzania, and Uganda, serving as pilot for other malaria-prone countries. Use of the MDAST framework to select optimal malaria interventions will not result in policy improvements unless existing barriers to implementing these policies are eliminated and appropriate incentives are put into place to activate the new policies and monitor their results. The tool and its implementation serve to identify extant barriers in each policymaking setting and provide opportunities to reduce them.

MDAST offers users a suite of potential malaria control interventions and models the simultaneous effects of these potential actions in a population. The tool relies on the established literature as the basis for modeling the disease and the effects of intervention. By permitting policymakers to consider alternative interventions, use of the tool may provide the means to identify solutions that were previously considered infeasible.

Barriers may exist specifically to the use of a decision making tool such as MDAST. Policymaking may be divided between various departments and ministries, central and regional government, and government and non-governmental organizations. MDAST is designed to provide policy makers with both a broad set of possible policy making options and the information necessary to engage in intersectoral dialogue about improved policy making.
This report summarizes the efforts of the MDAST project to document barriers to the optimal malaria control policies suggested by the tool, including a review of the literature, feedback from stakeholder activities, interactions with the WHO-coordinated steering committee, and surveys of stakeholders. Finally, the identification of barriers presents the opportunity to eliminate them. The role of MDAST in improving decision-making includes improved transparency and information made available to decision makers, and an improved platform for discussion between policymakers.

**BACKGROUND (LITERATURE REVIEW OF MALARIA POLICY BARRIERS)**

A review of the literature from the previous 15 years (1996-2011) on the term ‘malaria policy barriers’ was conducted using Google Scholar in July 2011, which identified around 16,700 potential papers. Google Scholar is an appropriate tool for a structured literature review on barriers to malaria policy making given the wide scope of disciplines which may document malaria interventions. Google’s proprietary search algorithm indexes and analyzes results from across all available academic databases on the internet. The first 200 listings in the search results were evaluated for their relevance and classified by topical areas. Of the first 200 articles, 72, or 36% of the total were deemed relevant for inclusion in this summary. Articles were excluded if they were: not on the topic of malaria control policy (66 articles); on malaria but outside of the scope of policy barriers (43 articles); not published in peer-reviewed articles (7 articles); and if they had a specific geographic focus outside of sub-Saharan Africa (12 articles). The oldest of the included articles from the first 200 results was published in 2004, and 10% of the articles were published in 2011, the year in which the review was conducted.

The papers identified for inclusion were evaluated to establish the general categories of classification of malaria policy barriers. Eighteen categories were established. The articles were then each coded by a reader to classify into multiple categories. This structured review generates a useful perspective of the published literature on malaria policy barriers.

A few of the papers included are review articles, and some include a direct discussion of policy barriers, while many focus on a specific intervention and identify barriers that exist to optimal malaria control policy in relation to the study. As with this report, the most important value in identifying barriers to optimal outcomes is the determination of opportunities to overcome these barriers. Thus, a literature on barriers to optimal malaria policy does not exist, per se, but rather a literature describing current shortcomings and potential for improvements in malaria control policy. The results of the literature review are being incorporated into a manuscript for forthcoming publication.

**RESULTS FROM 2010 STAKEHOLDER SURVEY**

As part of the MDAST project activities, malaria policy stakeholders from a range of sectors in Kenya, Tanzania, and Uganda participated in a survey distributed in July and August 2010 on current and optimal malaria policymaking activities in their country. A total of 97 individuals, identified as key stakeholders by MDAST project collaborators in each country, were surveyed (Kenya=33, Uganda=33, Tanzania=31). 47% of respondents reported working for government, 22% for universities, 9% for NGOs, and 20% for other types of organizations. 72% of the respondents primarily work in the health sector,
and an additional 12% work in the agricultural sector. The survey responses have implications for perceptions of barriers to optimal malaria control policy. Here, results are reported in aggregate from across all three countries.

Respondents from all three countries (n=97) overwhelmingly reported (78% agreeing) that there are additional people or organizations that should be included in malaria policymaking that are not currently. The free response section to this question elucidated which groups respondents believe should additionally be included, in particular local communities and researchers. Fully 20% of respondents wrote that local governments should be included, and 12% wrote that local communities should be included (respondents listed multiple groups). 19% of respondents named additional national-level government agencies that should be included in malaria control policymaking.

A number of questions from the survey indicate the differential between current practices and those practices considered optimal by the respondents. Respondents in all three countries indicated that donors should have much less influence over policy-making than they currently have and policymakers should consider research more frequently in policymaking. Respondents also indicated, though less strongly, that more attention should be given to the costs of alternative strategies. Respondents reported that all objectives related to malaria control should be given greater importance, but especially the objective of reducing poverty through malaria control and reducing the environmental impacts of malaria control. Considering human health, respondents indicated that development of vector and parasite resistance presents the greatest risk.

METHODS AND RESULTS FROM FIRST STAKEHOLDERS’ WORKSHOPS (AUGUST 2010)

Multi-sector stakeholder workshops are a key activity of the MDAST project. The first round of stakeholder workshops was held in each of the three participant countries during August 2010. At each of the workshops, participants expressed the need for malaria research to generate high-quality information and data specific to the situation in the country and/or the distinct regions within the country. In both the Kenya and Uganda workshops, participants stressed that the MDAST model in particular should be based on country-specific data.

Strategic integration of research efforts was a common theme across all of the workshops. Participants in Tanzania and Uganda specifically noted the importance of inter-sectoral collaboration in both research and malaria control implementation, e.g., related to (1) the agriculture sector regarding integrated vector management (IVM) and (2) health systems regarding indoor residual spraying (IRS). Participants in both the Uganda and Tanzania workshops noted that even though good tools for malaria control may exist or are being developed, politics and issues in the political process can obstruct effective implementation.

In the Uganda workshops, specific feedback included that there is a need to coordinate with the agricultural sector to develop an effective integrated vector management approach. Participants expressed concern that LLINs may become a much less effective approach to malaria control as vector resistance to pyrethroids. Some participants noted the need for development of a safe and effective non-pyrethroid insecticide, and concern regarding the contribution of the agricultural sector to pesticide
resistance. Participants were concerned about the sustainability of funding and resources supporting the broad malaria control agenda and the role of politics determining where resources are directed.

In Tanzania, stakeholders suggested that key institutions and politicians have failed to emphasize preventive approaches to malaria control, and that there must be a shift in the policy environment towards prevention. Participants also expressed concern about the potential impacts of the introduction of DDT for malaria control on trade and tourism. Stakeholders identified differential interactions of different levels of decision making and between internal and external motivations for change, e.g., at the national level in terms of donor preferences, as well as at the local level in terms of the implementation of strategies. Supportive laws and policy alone are insufficient for effecting change; the policies need to be enforced, and community involvement and ownership in the process must be fostered. Stakeholders noted the regional variation of policy implementation across Tanzania.

In Kenya stakeholders noted the need for a sustained venue for bringing researchers and policy-makers together (e.g., a national health research conference). Participants agreed that researchers need to learn to be better communicators, particularly with regards to making their findings accessible and meaningful to policy-makers. Politicians may often be crisis-oriented or face incentives incompatible with research results.

STAKEHOLDER CONSULTATIONS (AUGUST 2011)

In-country expert consultations were held in all three project countries in August 2011. The objectives of the expert consultation were to familiarize users and potential users from a range of sectors and levels with MDAST, elicit potential modifications or additions to MDAST, identify areas of weakness within MDAST, refine the strategy for full dissemination and implementation of MDAST, and identify mechanisms for MDAST to engender intersectoral collaborations. In order to accomplish the stated objectives, a team of primary MDAST project researchers closely involved with the development of the model and previous stakeholder engagement activities arranged to meet with key expert stakeholders involved in the National Malaria Control Program (NMCP) and/or other important malaria control entities in their respective home countries.

During the consultation, experts were given a presentation on the MDAST model, shown examples of its use, and then invited to participate in an interactive, hands-on demonstration during which the experts engaged in selecting model parameters for a range of alternative policy scenarios and generated a variety of model results. Following a discussion during which the experts’ feedback was elicited, time was allotted for individual written feedback according to standardized instruments, including a consultation feedback survey and an environmental module questionnaire administered to select participants to gain additional stakeholder input on prioritization of impacts to include in development of the environmental module. In-depth analysis of the feedback can be found elsewhere in the Progress Report for the period of January 1, 2011 – November 30, 2011 in the Report on The In-Country Expert Consultations (page 4). Of particular interest from that report is Figure 2, reproduced below along with the analysis contained in the report:
“Expert consultation participants were asked about their perceptions on how critical various barriers are to the implementation and/or dissemination of MDAST for decision making (Figure 2). Interestingly, the aggregate average across all countries for all potential barriers rated below 4 on the Likert scale, suggesting that on average participants did not perceive the issues as very critical barriers to the success of MDAST. The barrier that received the highest aggregate average (near 4 on the Likert scale) was “applicability to real life”, followed by “acceptance by superiors” and “limitations of relevant scientific research / data”. Respondents from Kenya showed on average a greater concern than the aggregate mean over a number of potential barriers, including acceptance by superiors, applicability to real life, donor preferences, the cost of implementing alternative strategies, and popular pressure / opinion. However, it is important to remember the small sample size when considering the extent to which these data can be used to make inferences at the country level.”

Figure 2: Please indicate how critical each of the following BARRIERS is to full implementation (or dissemination) of the tool for decision making?

- Limitations of relevant scientific research/data
- Donor preferences/agenda
- Popular pressure/opinion
- Cost of implementing alternative strategies
- Technological limitations
- Applicability to real life
- Uncertainty of outputs
- Acceptance by superiors

1 = Less Critical, 5 = Very Critical
ADDITIONAL SURVEY WORK

Student team members of MDAST conducted interviews and data collection activities in Uganda and Tanzania which provide useful input to the understanding of certain barriers in each country setting. In Tanzania, an expert elicitation was conducted with 19 experts on the benefits and risks of insecticide treated nets and indoor residual spraying. This exercise revealed important insights into the primary concerns facing policymakers. In Uganda, 34 stakeholders were interviewed for their perceptions of malaria and vector control, particularly with regards to the use of integrated vector management (IVM).

BARRIERS TO THE USE OF INTEGRATED VECTOR MANAGEMENT: RESULTS FROM UGANDA

In the Uganda IVM interviews, key barriers to vector management included budget shortcomings, a dependence on external funding, and a lack of internal political capacity to support vector control. 88% of participants indicated that they did not think Uganda would achieve the Millennium Development Goal for malaria by 2015. Respondents reported a variety of potential environmental risks for vector management in Uganda, and indicated a belief that IRS presents the greatest risk if mismanaged. 68% percent of respondents reported moderate or good intersectoral collaboration in IVM in Uganda. According to participants, IVM presents particular challenges in coordination of sectors, management of resources, information sharing, and the maintenance of political support. A majority of respondents (67%) feel that communities are actively being engaged in IVM but that community response is mixed. Community engagement is importance for acceptance, and respondents indicated opportunity for more local involvement in malaria interventions. An area of concern for IVM appears to be the application of research and evaluation results to policy change, which respondents report happens neither frequently enough or rapidly enough. Participants identified research for evidence based decision making as the key to successful IVM. However, participants responded also that the greatest current barrier to improved malaria vector control in Uganda is program financing.

RISK-RISK TRADEOFF OF PESTICIDES IN MALARIA CONTROL: RESULTS FROM TANZANIA

The expert elicitation in Tanzania was conducted to gain information on risks of malaria control efforts which currently are characterized by high level of uncertainty. In particular, the expert elicitation sought to describe the tradeoffs between risks of malaria and risks of malaria control (risk-risk tradeoffs). The interviews revealed greater concern for the risk of DDT in IRS as compared to ICON (a pyrethroid). However, respondents noted that while the insecticides of IRS are dangerous, properly conducted IRS itself presents low risk to human health. In comparing intervention policy, respondents noted the significant uncertainty of outcomes due to a multitude of factors, including reductions in immunity and movement of people. A majority of respondents in a discussion about risk-risk tradeoffs considered the current risk (and burden) of malaria to be of much greater concern than the risks of malaria control, but some respondents noted the complex long term risks, such as the environmental risks.
OVERCOMING TECHNICAL BARRIERS

While MDAST is designed using state-of-the-art decision modeling software (Lumina Analytica; Los Gatos, CA), careful attention has been placed on producing a model that is useable by policy makers in Kenya, Tanzania, and Uganda on available computer infrastructure. The model can be run on a laptop or netbook, or on a relatively modern desktop. The interface of the tool is designed in an easy to understand, non-technical format. However, it is possible for the user to view the technical model structure if desired. The model will be available for download from the project website, which will ensure availability of the most up-to-date version, and will be accompanied by a user manual and additional supporting materials.

OPPORTUNITIES AND INCENTIVES: THE ROLE OF MDAST

The existence and identification of barriers to optimal malaria control activities can productively be viewed as a set of opportunities to improve interventions. In understanding the complex nature of malaria control, we must recognize that the incentives for policymakers may differ from the incentives of individuals affected by malaria control policies. For example, a head of household is going to be concerned about immediate, affordable treatment options, while policymakers may be more concerned with the possibility of the parasite developing resistance to treatment.

MDAST is designed to give policymakers the ability to consider interventions in concert. However, recognizing that traditionally multiple agencies and organizations implement the variety of malaria control and treatment programs, key to improved policymaking is better coordination amongst policymakers.

In the implementation of MDAST, the facilitators, partners, and stakeholders should use the opportunity to prompt cross-sector discussion about barriers to improved malaria policy-making. An effective computer model such as MDAST is inadequate in and of itself to alter the outcomes of control efforts. While the computer-based tool is itself a carefully designed resource for policymakers, the potential benefits of the tool will only be realized if the stakeholders and project partners use the tool as an opportunity for increased communication and collaboration in malaria policymaking.
Below is a draft excerpt on IRS from the matrix of barriers and opportunities. The complete matrix contains a range of control methods from vector control, prevention, diagnosis, and treatment categories. An excerpt is presented here as an example of the matrix structure. The matrix is being incorporated into a manuscript.

### DELIVERY REQUIREMENTS, BARRIERS AND OPPORTUNITIES, AND FEASIBILITY FOR VARIOUS MALARIA CONTROL METHODS

<table>
<thead>
<tr>
<th>CONTROL METHOD:</th>
<th>SCALE OF ACTION:</th>
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<tr>
<td>Vector Control</td>
<td>Individual/ Household</td>
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<tr>
<td>IRS (DDT)</td>
<td><strong>Actions needed</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Barriers and opportunities</strong></td>
</tr>
<tr>
<td>IRS (pyrethroids)</td>
<td><strong>Actions needed</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Barriers and opportunities</strong></td>
</tr>
</tbody>
</table>
REFERENCES


Mubyazi, G.M. et al., 2010. Women’s experiences and views about costs of seeking malaria chemoprevention and other antenatal services: a qualitative study from two districts in rural


PLAN FOR CONDUCTING VALUE OF INFORMATION ANALYSIS (ACTIVITY 5)

BACKGROUND

Dr. Dohyeong Kim at North Carolina Central University (sub-contracted agency) has begun to perform value of information (VOI) analyses to identify knowledge gaps and create policy-relevant research agenda (Activity 5 in MSP). Although the full-scale VOI analysis may not be performed until the MDAST modeling is completed, the team decided to start identifying in the literature what aspects and parameters of malaria transmission are promising for VOI analysis. In fact, the literature contains relatively few examples of analysis which has been applied to evaluate uncertainty and sensitivity of malaria or health-related decision modeling outcomes. This presents an opportunity for MDAST to contribute to this underdeveloped area.

Based on the review of general VOI literature, we defined VOI in our research framework as a decision-improving value of additional information about malaria outcomes. In other words, we attempt to evaluate the social value of being able to know the risk information, with a certain level of uncertainty due to lack of knowledge and/or research findings, before making a series of policy decisions. The findings of this effort should offer guidance on comparing the benefits of acquiring additional information with the costs of acquiring such information, and investing optimally in the acquisition of new information that will in turn support better choices among control options.

VOI WORK PLAN

We have then devised a VOI analysis work plan containing the following 3 steps:

(1) Perform a sensitivity analysis to determine which parameters are most influential in determining model results (by end of December 2011)

(2) Identify areas where influential parameters are missing or involve high levels of uncertainty (by February 2012)

(3) Estimate the VOI and compare with COI (costs of information) to create a policy-relevant malaria research agenda for project countries (by April 2012)

As a preliminary approach regarding the first step, we will focus on key LLIN parameters to assess how sensitive the key MDAST modeling output measures are to each parameter and to determine the level of uncertainty and existing information associated with each parameter. Once we determine the best
approach for conducting VOI analysis (full modeling vs. limited modeling), we will expand our focus to all
other modules to identify several important parameters that are responsible for most of the uncertainty
and then create a policy-relevant malaria research agenda for Tanzania, Kenya, and Uganda.

This approach will enable users of the MDAST models to invest optimally in the acquisition of new
information that will in turn support better choices among control options and improve collaborations
between researchers and policymakers to improve the effectiveness and feasibility of the MDAST
models in each and every country.