Mobile Solutions for Malaria Elimination Surveillance Systems: A Roadmap

Executive Brief
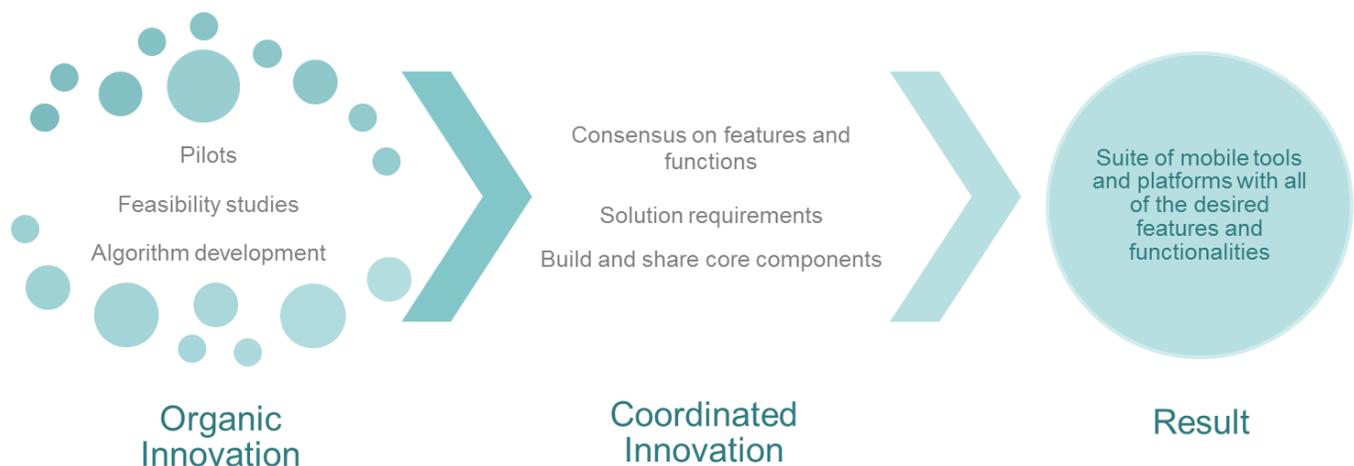
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Vital Wave^{SM}

INTRODUCTION

Malaria cases and deaths fell steadily from 2000–2015 under the Millennium Development Goals framework. Such tremendous progress was made that the global community elevated its goal from malaria control to malaria eradication. Malaria eradication, in part, relies on timely and accurate data to effectively identify areas of ongoing transmission, target interventions to stop transmission, and measure progress toward elimination. However, a key gap curbing progress is the lack of appropriate tools for collecting and managing malaria data. Most data collection systems are slow and generate incomplete, inaccurate, and highly aggregated data. Elimination-ready systems must be capable of getting the right information to the right person at the right time.

The potential role of mobile tools to strengthen and extend the reach of disease surveillance systems is widely recognized. While a variety of tools have been piloted and introduced, each with its own strengths and limitations, few have scaled and none meet all the malaria community's surveillance needs. The current approach to tool development has led to a fragmented environment in part due to the lack of an articulated vision of where mobile tools fit into the landscape and what features are critical to include. A critical element of appropriate and comprehensive solution design will be collaboration across the malaria community, including donors, malaria program experts, technology experts responsible for solution design and software development, and those working in other health sectors (e.g., polio, maternal-child health, etc.). Such an approach would help transform a fragmented process into one of "coordinated innovation" (see Figure A below).

Figure A. Moving toward Coordinated Innovation

Pilots
Feasibility studies
Algorithm development

Consensus on features and functions

Solution requirements

Build and share core components

Suite of mobile tools and platforms with all of the desired features and functionalities

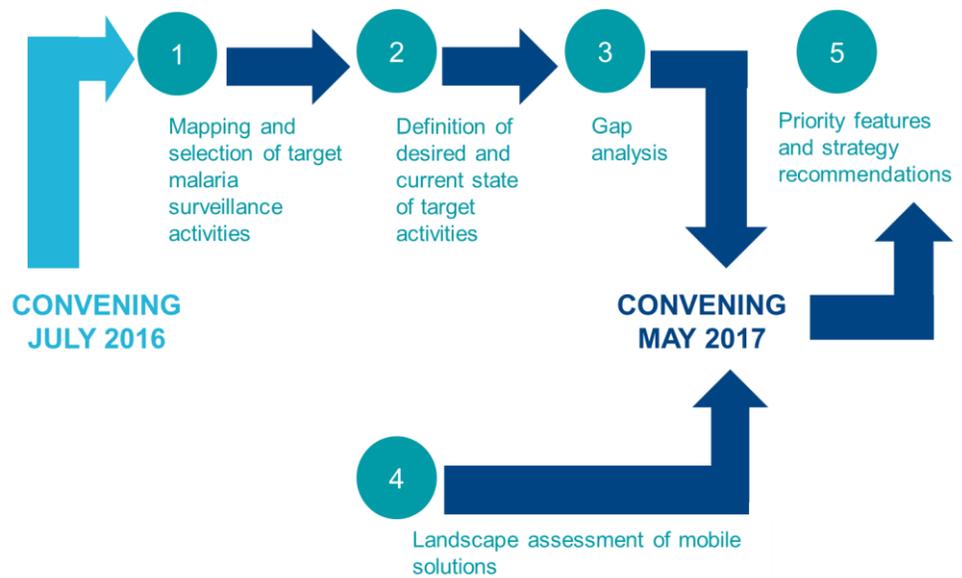Organic Innovation

Coordinated Innovation

Result

To support the transition to this collaborative approach, the Bill & Melinda Gates Foundation engaged Vital Wave to identify actionable next steps for developing mobile tools for malaria surveillance and to facilitate continued discussions among the malaria community, encouraging collaborative and scalable approaches to the design of mobile solutions. This report, *Mobile*

Solutions for Malaria Elimination Surveillance Systems: A Roadmap, is the result of a rigorous, methodical procedure breaking down the complex processes of malaria surveillance into discrete tasks and activities as well as identifying who takes those actions, what information they need, the timeframe in which the activities must happen, and how the activities relate to each other. This business analysis approach is a best practice for software development.

PROJECT OVERVIEW

As shown in Figure B, Vital Wave's work was divided into five phases: (1) mapping the desired state of malaria surveillance activities, (2) identifying the actual activities and needs of current malaria surveillance programs, (3) conducting a gap analysis between the desired and current states for malaria surveillance programs, (4) performing a landscape assessment of existing mobile tools, and (5) developing a list of priority features that a mobile solution needs in order to fill the gaps between the current and desired states and providing a set of recommendations for how the community can move forward.

Figure B. Project Overview

1 Mapping and selection of target malaria surveillance activities

2 Definition of desired and current state of target activities

3 Gap analysis

5 Priority features and strategy recommendations

4 Landscape assessment of mobile solutions

CONVENING JULY 2016

CONVENING MAY 2017

KEY FINDINGS

The need for case and focus investigations to occur in the field informs the need for mobile tools.

An assessment of the universe of malaria surveillance activities reveals that case and focus investigations both increase in importance as countries move into the elimination phase and very few mobile tools currently exist to target these activities. This indicates an opportunity for catalyzing mobile tool innovation for field-based teams conducting investigations. Through an extensive mapping process for both case and focus investigation activities, key themes emerged that inform the features required to enable mobile tools to bring the highest value to surveillance activities:

- ▶ **Case and focus investigations often take place in parallel rather than sequentially.** Many of the field-based activities performed during case and focus investigations overlap significantly, indicating that a mobile solution needs to support the needs of both case and focus investigations.

- ▶ **Geolocation of more than just households is necessary.** While both case and focus investigations require the collection of geolocation data to track cases, the unit that is geolocated (e.g., the index case, the household, the structure, the human settlement, or the focus area) varies depending on whether it is a case or focus investigation, on the country policy, and on the stage of elimination.

- ▶ **Information relevant to both investigations includes diverse data sets.** Both case and focus investigators need to collect and verify case-based and environmental data and update existing records with new data while in the field. Tools must be designed to support a variety of datasets and be customizable to meet requirements at the country level.

- ▶ **Data visualization across a number of data sets is highly valuable.** Visualizing multiple layers of data while in the field is necessary to conduct well-informed investigations. An additional value-add of a mobile solution would be dynamically locating the user on a map and providing GPS-based navigation to specific locations.

- ▶ **Field-based teams experience limited connectivity.** Given the location of investigations, the ability to collect and review data offline on a mobile device is a critical need, as is functionality related to syncing to a server or database once back online.

- ▶ **Limited resources are available to conduct investigations.** The lack of highly skilled personnel such as entomologists and the significant human resource burden placed on frontline health workers in many countries require improved access to mobile-supportive supervision and job aids in the field to conduct complex malaria-specific tasks. Additionally, investigators require tools with basic analytical capabilities to devolve decision making from the national or district level, empowering local health workers to take action when appropriate.

Designing a tool that meets the needs of field teams implementing case and focus investigations requires the development of specific features and capabilities. A comprehensive list of priority ("must have") and nonessential ("nice to have") features that mobile tools and platforms must support are a key output of this report. These required features can be categorized into one of seven types listed in Figure C below.

Figure C. Key Technology Feature Types for Malaria Surveillance

Case-Based Data	Ability to collect, store, look up, and use data tagged to a unique case[1]
Timely Data	Ability to submit and access data in real time to enable decision making
Analytics	Ability to conduct analysis and visualization of data from multiple viewpoints and dimensions
Geolocation	Ability to collect and review accurate geospatial data for both patient and environmental data
Interoperability	Ability for a tool to "speak to" other systems in order to import, export, use and understand data from those systems
Offline Capability	Ability to perform tasks (e.g., data collection, analysis, review) without Internet connection
Support Capabilities	Ability to leverage job aids, decision trees, performance management modules, and other training-related components to build capacity and improve workers' efficiency and effectiveness

[1]A case means any entity (people, households, foci, and other geospatial features) to which data can be associated (through a form or metadata).

Multiple existing tools provide a solid foundation, but enhancements are required to meet all malaria surveillance activity needs.

A landscape assessment of existing and in-development mobile tools and platforms reveals the key technology strengths and gaps in current mobile tools' features. Enhancement or new development in each feature type will be necessary to improve functionality. Examples of critical gaps are detailed below.

Case-Based Data: Current platforms are not simple to configure or customize, are unable to collect data in a non-sequential way that better matches the realities of data collection in the field, and do not support complex or non-hierarchical relationships between cases.

Timely Data: Sending and receiving timely data in the field from the central server depends on access to network connectivity. In addition to this, existing digital health platform technologies do not readily plug into widely used communications platforms (e.g., WhatsApp, Facebook).

Analytics: Current mobile-based platforms do not provide needed basic analytical capabilities to field staff, such as the ability to analyze a data set in real time in an offline environment.

Geolocation: Current mobile-based platforms do not support the required quality and detail for maps while offline, do not store sufficient data offline to support visualization of numerous geospatial features, do not support projection of geographical areas based on location, and do not provide software development kits (SDKs) that allow programmers to leverage available geospatial data (e.g., from Open Street Maps).

Interoperability: Standards have not yet been defined or agreed upon for geospatial features for malaria surveillance, nor has support for such standards been built into current platforms.

Offline Capability: Peer-to-peer synchronization and conflict resolution so that data collected by multiple users is not overwritten, is not a mature feature in current platforms.

Support Capabilities: Current platforms do not support robust tools for field-based task management and work planning, nor do they have the ability to analyze data collected in real time or to allow users to create, update, or modify a task list.

Despite the gaps identified above, it is clear that mobile tools and platforms can support the shift to malaria elimination and that aligning efforts and investments to build on existing technologies and progress to date is a feasible goal. This report recommends building a multi-platform toolkit where priority features are developed across a suite of interoperable but separate platforms. Using this approach, current technologies would be strengthened through the development of prioritized features as stand-alone pieces inside one or more platforms, while foundational components of mobile solutions—which can be reused on multiple mobile technologies—could also be developed. This approach would enable multiple platforms to be integrated and used together to support the complete set of required features or, alternately, for platforms that provide similar features to be swapped in and out as needed. This would give countries the opportunity to continue working with tools that they have already incorporated into their health information system and to select additional tools that are best suited to their program implementations.

RECOMMENDATIONS AND NEXT STEPS

Closing technology gaps requires a "Coordinate to Innovate" approach.

The recommendations below are for the broader malaria community, including program experts, technology providers, and donors. They point to actions that can be taken to ensure mobile tools meet countries' malaria elimination program needs and describe a development approach that uses investments in an efficient and effective manner. The recommendations focus on specific technology development actions and how stakeholders can work together in a more coordinated and streamlined method.

Create a mechanism for increased collaboration among those working on mobile tool development for malaria surveillance.

▶ Create an organizational structure for coordinating collaboration on mobile tool development and agreement on using technology and program standards for malaria surveillance. Use this structure to engage the donor community and to encourage them to align their investments.

▶ Develop principles and agreement templates for collaboration and knowledge-sharing between technology providers.

▶ Establish a software development process that supports the creation of a modular, interoperable, and mobile toolkit that can be implemented on one or more mobile platforms best suited to individual programs and locations.

▶ Increase collaboration with other developers of software solutions for disease management to benefit from their work, leverage existing knowledge for malaria surveillance activities, and share what the malaria community has learned.

▶ Develop mechanisms to ensure all mobile technology development efforts adhere to the Principles for Digital Development, especially in gaining user input into the design.

Streamline and enhance software development activities to better meet program needs.

▶ Complete validation of needed features for case and focus investigations with members of the wider malaria community, including ministries of health and end users.

▶ Conduct a similar process to identify the needed features for case detection and notification and the intervention response. Prioritize these features as "must have" or "nice to have."

▶ Identify the user scenarios for each part of the malaria surveillance program, and identify a package of features that would be needed for each user in a mobile tool.

▶ Perform a detailed technical examination of existing mobile platforms against the to-be-developed full list of prioritized features and standards and identity gaps that remain. This activity will inform additional "must have" features to be developed, customized, or enhanced.

▶ Consider a prototyping process for rapid iteration between technology providers and program implementers on new or improved tools. This process would gather feedback from end users as well as program experts.

This report discusses the implications for mobile tool and platform development and makes recommendations about next steps. It creates a collective understanding and evidence base for malaria experts and technology providers about the landscape of mobile tools for malaria surveillance, the trade-offs and nuances of critical features, and the technology gaps that may require additional, targeted investment. The ingenuity and creativity of the malaria and technology communities have resulted in a rich array of mobile tools and platforms, and the findings and recommendations in this report point to concrete actions that can be taken to enhance progress in this continued effort.