This guide is intended for health program managers that want to integrate mobile health solutions into their health systems. It provides organized and accessible information on how to determine whether mHealth is suitable, and then how to plan, design and operationalize a successful mHealth implementation. Building significantly on previous eHealth project management guides, this document specifically focuses on issues pertaining to mobile health.
Prepared by

Kelly Keisling

Acknowledgements

This guide draws significantly from the content of other sources, particularly “Planning an Information System Project” by PATH and WHO, the “Mobile Technology Handbook” by PACT, the “mHealth Planning Guide” by K4Health, and the mHealth Compendium by the African Strategies for Health project. Instead of original authorship, these and other sources are incorporated to reuse and introduce available knowledge. Links to these and other resources are available in the Useful Resources section at the end of this guide.

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AUGUST 2014
Executive Summary

Mobile technology for health, or “mHealth”, presents many opportunities for improving health outcomes, either in the healthcare system for diagnosis and treatment, or in the broader health system for prevention and promotion of wellbeing.

mHealth is the use of mobile technology to support health projects and outcomes, including the processes and programmatic aspects that accompany the technology. Mobile technology can include such devices as mobile phones, tablets, or personal digital assistants (PDAs).

This guide provides organized and accessible information on mHealth for health program managers that intend to implement mHealth. Health program managers have significant control over whether and how mHealth is used, but they often lack capacity in mHealth. This guide helps health program managers to understand and prepare for the activities and investments that enable successful mHealth.

Methodical preparation and allocation of resources can increase the potential and minimize the risks of mHealth. These methods and resources are discussed in the overview below.

mHealth projects perform numerous fundamental steps, including Design, Development, Implementation, Evaluation and Scale Up and Sustainability. These basic steps are familiar to health project managers. However, each of these steps requires methods for mHealth.

- Define goals & outcomes to focus on project needs, not technology.
- Form a multidisciplinary team that can manage every project function.
- Understand the user and document user needs as “requirements”.

- Select the acquisition model to build, buy, or adopt a system.
- Select the technology provider based on requirements.
- Select mobile devices only after determining requirements.
- Develop content aligned with user needs.
- Conduct user-centered design and testing.

- Partner with traditional and nontraditional actors.
- Estimate total cost of ownership.
- Develop an implementation plan with milestones.
- Prepare for roll out: demand creation, training, support & documentation.
- Ensure sufficient staff time for project management.
- Foresee common risks and manage risks.

- Monitor and evaluate accounting for unique challenges of mHealth M&E.

- Select the acquisition model to build, buy, or adopt a system.
- Select the technology provider based on requirements.
- Select mobile devices only after determining requirements.
- Develop content aligned with user needs.
INTRODUCTION
### 1. Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>A generic term for the work that is performed in the business process. The types of activities are tasks and sub-processes.</td>
</tr>
<tr>
<td>Airtime</td>
<td>The time spent talking or otherwise using the voice function of a mobile device; mobile carriers determine billing charges based on the airtime used.</td>
</tr>
<tr>
<td>Application</td>
<td>Also called “app”, a small, specialized piece of software that can be downloaded onto a mobile device.</td>
</tr>
<tr>
<td>Automating</td>
<td>Attempting to reduce an existing manual job to a set of computer programs that can replace the existing manual effort with a minimum of human effort.</td>
</tr>
<tr>
<td>Basic phone</td>
<td>Device with basic phone functionality (e.g., SMS and voice), very limited computing power, few connectivity options, and a basic user interface and numeric keypad.</td>
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<tr>
<td>eHealth</td>
<td>Electronic health is the broad term used here to describe electronic processes and communication to support health (broadly) and healthcare (diagnosis and treatment). It incorporates mobile Health.</td>
</tr>
<tr>
<td>End user</td>
<td>Those who directly interact with the mHealth application or service. An end user may be a beneficiary or health staff, but are not IT professionals.</td>
</tr>
<tr>
<td>Feature phone</td>
<td>Midrange mobile device with a graphical user interface, basic apps, and more numerous connectivity options than a basic phone, but without a smartphone’s computing power and QWERTY keyboard.</td>
</tr>
<tr>
<td>Form factor</td>
<td>The size, shape, and style of a mobile device.</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic information system. A platform designed to capture, edit, analyze, and visualize geographic or spatial data, usually via a map.</td>
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<tr>
<td>GPRS</td>
<td>General packet radio service. A data transmission system similar to SMS but without limits on the number of characters or transmission size.</td>
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<tr>
<td>GPS</td>
<td>Global positioning system. A network of satellites that broadcast signals read by handheld GPS units or other GPS-enabled mobile devices to calculate a precise location using latitude and longitude coordinates.</td>
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<tr>
<td>ICT</td>
<td>Information and communications technology.</td>
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<tr>
<td>ICT4D</td>
<td>Information communication and technology for development. The use of mobile and computing devices to improve development outcomes.</td>
</tr>
<tr>
<td>IM card</td>
<td>Subscriber identity module. A small card inserted into a mobile device on which phone numbers, contact information, and other data are stored.</td>
</tr>
<tr>
<td>IT</td>
<td>Information technology.</td>
</tr>
<tr>
<td>IVR</td>
<td>Interactive voice response responds to voice prompts from users.</td>
</tr>
<tr>
<td>mHealth</td>
<td>Use of mobile technology to support health projects and outcomes, including the processes and programmatic aspects accompany the technology.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<td>-----------------------------</td>
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<tr>
<td>Mobile platform</td>
<td>The system that receives the data sent from mobile devices. The various mobile platforms have varied features and functions, including data storage, data verification, data analysis, and data reporting.</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>QWERTY</td>
<td>The standard layout of an English keyboard, with the letters q, w, e, r, t, and y positioned in that order, reading from left to right, on the top row of alphabetic characters.</td>
</tr>
<tr>
<td>RFP</td>
<td>Request for proposal.</td>
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<tr>
<td>SaaS</td>
<td>Software as a service.</td>
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<tr>
<td>Skip logic</td>
<td>Instructions programmed into a mobile-based questionnaire that will present a different series of questions to the user based on a previous response. Also known as conditional branching.</td>
</tr>
<tr>
<td>Smartphone</td>
<td>High-end, full-featured mobile device with touchscreen graphical user interface, on-screen or hard-button QWERTY keypad, advanced computing power, downloadable apps, GPS receiver, and multiple connectivity options.</td>
</tr>
<tr>
<td>SMS</td>
<td>Short message service. System for sending short messages of a fixed length—traditionally a maximum of 160 characters in English, with other lengths in other languages.</td>
</tr>
<tr>
<td>Tablet</td>
<td>Full-featured mobile device with large touchscreen graphical user interface, on-screen keyboard, advanced computing power, downloadable apps, GPS receiver, and multiple connectivity options. Tablets typically lack SMS and voice communication options.</td>
</tr>
<tr>
<td>TCO</td>
<td>Total cost of ownership.</td>
</tr>
<tr>
<td>Unstructured Supplementary Service Data (USSD)</td>
<td>Protocol used by mobile telephones to communicate with the mobile service provider.</td>
</tr>
<tr>
<td>Use case</td>
<td>A description of system behavior – what a system does- in terms of sequences of actions.</td>
</tr>
<tr>
<td>User interface (UI)</td>
<td>The screen that a user interacts with to operate a mobile device. Basic phones and some feature phones are display only. Other feature phones, smartphones, and tablets use larger touch screens for richer interaction and usability.</td>
</tr>
</tbody>
</table>
2. Introduction

The potential for improving health outcomes across the board using mobile technology is enormous, especially in the developing world where health systems are under resourced and over utilized and struggle to reach poor and rural populations especially. With mobile phone penetration increasing each year, and access to phones with greater functionality increasingly becoming the norm, there is enormous potential to reach millions of people with health information and services.

Sitting on the cross-over point between technology and health systems, mHealth requires a wide range of skills and experience; skills and experience which seldom sit within a single person or team. Planning, designing, implementing and sustaining mHealth projects thus requires a systematic and coordinated effort between a wide range of stakeholders, with different backgrounds, goals and priorities.

Furthermore, in order to reach its true potential, mHealth systems need to be properly integrated into broader health systems so that they form part of the larger whole and are not seen as stand-alone projects. This requires an additional level of planning and co-ordination to ensure that technologies and database are compatible with existing systems (both human and technical) and have necessary local support.

Finally, mHealth systems implementers need to pay particular attention to how their projects are perceived. Efforts need to be made to ensure that risk-adverse government officials and facility administrators actually buy-in to the concept and accept that there is real evidence of the benefits of the system, that they are stable and low risk. Without this buy-in, mHealth projects are unlikely to proceed beyond the pilot or be granted sustainable funding.

All these challenges can be overcome through careful planning and project management, and by involving the correct stakeholders at every stage of the process, and making informed decisions. This is not to say that every mHealth project will be successful, many won’t, but the lessons learnt over the past ten years provide valuable insight into key aspects of mHealth project success.

3. Understanding Opportunities for mHealth

Mobile health, or “mHealth” uses mobile and wireless technologies to provide health services and information. This can include use of mobile phones, personal digital assistants (PDAs), tablets, mobile applications and wireless medical devices. mHealth is a subset of eHealth, which uses a broader range of information and communications technologies (ICT) for health, such as desktop computers and land-line internet. In turn, this is also a subset of the cross-sector use of ICT for development (ICT4D). mHealth can be integrated within eHealth and ICT4D for greater utility and cost saving.
4. Types of mHealth

Mobile technologies do not physically deliver commodities, personnel and equipment, but they can deliver related information for health projects. It can serve healthcare providers and project staff, as well as beneficiaries. mHealth can support many areas of the health system and many types of health projects. Some of these types of mHealth are illustrated in the case studies below. The types of mHealth functions are constantly evolving and expanding. A mHealth project can also combine multiple mHealth functions to serve multiple needs of a user or multiple types of users. Projects initially conceptualized to serve a specific need or user group may expand over time.

Figure 1: Types of mHealth

5. Evidence

The evidence base for mHealth is limited but growing. Critiques cite the insufficiently rigorous evaluation in hundreds of pilot studies of mHealth. However, there is a growing body of high-level evidence with 40 new studies added to the clinicaltrials.gov database between May and November 2012 alone. Literature on mHealth evidence is available at www.mhealthevidence.org.
6. Issues in mHealth Implementation

While mHealth presents tremendous opportunities, numerous issues can present challenges to implementation. Categories of issues for mHealth implementations are listed below, followed by a suggested response or consideration based on lessons learned.

- **Quality of design.** Sufficient time, budgeting and methods are required for design.
- **Narrow technological approach to ICT.** Understand the needs of users and beneficiaries.
- **Changes in communication patterns.** Fit users’ communication patterns and preferences.
- **Changes in the power structure.** Understand how gender can influence project design.
- **Demand.** Demand generation can support adoption by users and gatekeepers.
- **Modifications to planned implementation.** Reduce modifications with simple designs.
- **Project planning and management.** Sufficient time, staffing and supervision are required.
- **Costs.** Costs vary over the short-term, medium term and long-term.
- **Organizational capacity.** Trainings, guides and technical assistance can address gaps.
- **Government commitment and capacity.** Align with government goals and expectations.
- **Partnerships.** Development and scale up can shift responsibilities to new partners.
- **Failure to Scale Up ("Pilotitus").** There are thousands of mHealth pilots worldwide but very few mHealth projects that can really be said to have gone to scale. In order to ensure that projects don’t remain pilots, it is essential to plan for scale from the beginning.
CASE STUDIES
7. Case Studies

Sistem Informasi Jejaring Rujukan

Maternal & Neonatal Referral Exchange System Implemented in Indonesia by RTI with EMAS partners

TYPE OF MHEALTH: REFERRAL

Sistem Informasi Jejaring Rujukan Maternal & Neonatal (SIJARIEMAS) supports midwives’ referral of mothers and newborns to hospitals. It also supports follow up visits and education after mothers return home. A midwife identifies a complication then sends an SMS with patient data, vital-signs, diagnosis and pre-treatment information to the SIJARIEMAS system. The system automatically routes the message to the nearest hospital based on the referral pathway registered into the system. Referral hospital staff assess whether they are able to handle the patient and either accept or reject the referral. If accepted, the incoming referral notification is automatically forwarded to the emergency team. If rejected, the system routes the message to the next closest hospital, or informs the health provider at the local health facility to treat the patient locally based on advice from the hospital doctor. Midwives are kept up to date on the referral status via phone. For some emergency information, the hospital will make a follow up call to the midwives or midwives can also call doctors through the hospital call center.

RESULTS

The system referred 7,145 cases between January and September of 2013. 90% of referrals were communicated by SMS and 10% by phone calls. 77% of cases are responded to by the hospital in under 10 minutes.

Wired Mothers

Implemented in Tanzania by University of Copenhagen, Ministry of Health, Health Sector Programme Support Zanzibar; Danida Health Sector Programme Support.

TYPE OF MHEALTH: BEHAVIOR CHANGE COMMUNICATION

Wired Mothers promotes access to antenatal care and skilled attendance at birth delivery, as recommended by WHO. The project links pregnant women with their primary care provider. “Wired mothers” receive appointment reminders and educational information via mobile phone. The mothers also used phone vouchers to call their primary care provider with to discuss any medical issues. Mobile phones were also used by health facility staff, ambulance drivers and referral hospital employees to strengthen communication between different levels of the health system.

RESULTS

Wired mothers was evaluated by randomized control trial with 2,550 pregnant women, including 1,311 in the exposure group that participated as wired mothers. 64% of women in the exposure group had skilled delivery attendance at birth, versus 40% for the control group. The impact was greater among urban women.
Project Optimize

Implemented in Albania as a partnership between WHO and PATH in collaboration with the National Immunization Program and Berlinger.

TYPE OF MHEALTH: SUPPLY MANAGEMENT

The project tested an SMS-based system to monitor and log temperature conditions in peripheral cold chain equipment. The aim was to assess whether these remote alarm systems facilitate better vaccine and cold chain management than non-connected temperature loggers.

24 health centers storing vaccines were equipped with remote temperature monitoring devices that included sensors, monitors and SMS gateways. When an alarm is activated due to exceeded temperature limits, an SMS text message is sent to a central server that notifies health workers and supervisors in charge of the storage location. Detailed temperature logs are periodically sent to the central server via SMS, which also stores alarm notification data.

RESULTS

Over a 10-month period, 136 alarm incidents were detected, including 22 low- and 114 high-temperature alarms. The system also demonstrated certain managerial benefits. For example, supervisors phoned health workers or storekeepers in 41% of incidents to confirm detection of the problem and assisted in taking appropriate follow-up measures in 15% of these. In focus group discussions, nurses and supervisors reported that the technology was beneficial for their work. However, while the study highlighted some qualitative benefits of the technology, it did not find any situation in which remote monitoring saved a vaccine from freezing or excessive temperature exposure. Therefore, a case for positive cost-benefits could not be made.

Child Profiling Survey

Implemented in Swaziland by Pact Swaziland, Save the Children Swaziland (SCSWD) and the Coordinating Assembly of NGOs (CANGO)

TYPE OF MHEALTH: DATA COLLECTION AND REPORTING

A mobile technology platform was selected for use in a child profiling exercise of 10,244 orphans and vulnerable children (OVC). The survey looked at service needs in child protection, education, child abuse and psychosocial support needs. It gathered data for programmatic and budgetary decisions to improve and provide targeted, quality services to OVCs throughout Swaziland. GPS coordinates mapped service coverage and areas of highest needs.

RESULTS

10,244 children were surveyed, showing nearly 3,000 children were orphans, 7,284 were determined to be vulnerable, 2,993 children did not have birth certificates or national IDs, and 331 children had dropped out of school. As a result of these data, Save the Children Swaziland realigned its budget to cover the programmatic and administrative costs of providing targeted services to the children identified in the survey. GPS data at the household level allowed for budgeting of staff time and fuel costs for providing the services, as well as key programmatic costs such as assisting children to obtain their necessary national documents.
eNUT

Implemented in Zanzibar by D-tree International, in partnership with Zantel, supporting a Government of Zanzibar project.

TYPE OF MHEALTH: ELECTRONIC DECISION SUPPORT

eNUT was built to streamline the management of information and support the decision-making needs of health workers, helping them to implement the national guidelines for providing effective treatment to children suffering from malnutrition. The eNUT software provides an interactive mobile version of the government-approved treatment guidelines for acutely malnourished children. Used by government health workers, primarily nurses, the application takes them step-by-step through the guidelines using data from past and current visits to assess the child’s progress and determine the next steps for effective treatment. Nurses can access patient data, enter new data and schedule appointments. The software captures the data that the nurse enters during the patient visit, providing the health service administrators with real-time access to program data and improving overall decision-making abilities.

RESULTS

Independent evaluation concluded that the intervention sites were 20% more accurate in diagnosis than the non-project sites. A qualitative survey of the health workers’ perceptions about the application found that a majority of the users reported an improved ability to register and screen children, an easing of workload, and improved skills and capacity.
DESIGNING, DEVELOPING AND IMPLEMENTING mHEALTH
8. Designing, Developing and Implementing mHealth

Define Goals and Outcomes

Consider the project needs

Good design begins with a focus on the project needs, not a focus on technology. While technology can be very attractive, premature choices on technology can lead to costly presumptions. Technology design arises from project needs, and these needs provide the justification for introducing technology. Since mHealth is not a standalone effort, it must fit with project components. These considerations can include:

- What are the goals and outcomes of the project?
- What evidence-based practices would be supported?
- What are the barriers to implementing the practices and project?
- How can the project’s information, availability, quality, acceptability, utilization, efficiency, or cost be improved?
- How can mobile technology help implement the project or strategy?
- Which project components and stakeholders could benefit from improved communication, data or payment methods?
- What is the economic rationale for investment in mobile technology?
- What is the definition of success and how is it measured?

Draft the initial scope of the project

There are different types of scoping that can be done for each project:

- **Functional scope** describes what mobile technology does. For example, does it promote access to service delivery or track client referrals to points of service delivery?
- **Programmatic scope** describes which health programs will use mobile technology. Will it cover one program or will it be integrated with many?
- **Geographic scope** of the system includes where and who will use the mobile technology. In which districts, service delivery channels or levels of the health system will mHealth be used?

Scopes often begin with a limited focus, then later expand in terms of functionality, program integration and geographic coverage. Beginning with a limited focus can make the project more manageable and adaptable.

Beginning with a scope and outcomes provides a vision that steers choices about project design and management. Project scope can indicate who the stakeholders will be, and provide stakeholders with a common goal.

It is important to plan for continued evolution of the project scope as steps are completed and stakeholders provide continuing input. Lack of flexibility about project goals and scope can slow necessary modifications and increase project costs and risks.

Estimate the feasibility of the project.

Before determining whether to make a major commitment to mHealth, consider whether the scope is feasible in your situation. Feasibility can be technical, operational or economic.
**Table 1: Project feasibility considerations**

<table>
<thead>
<tr>
<th>TECHNICAL</th>
<th>Is technology available to perform the functions? Can a new system be developed or upgraded given current resources? See the mobile technology landscape analysis below for technical considerations.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using technology that is incompatible with internal technology assets or the external technology environment can limit capabilities and savings.</td>
</tr>
<tr>
<td>OPERATIONAL</td>
<td>After the mHealth project is developed, will it be operable? Have you worked with end-users to ensure that the plans will be implemented and the technology will be used? See the mobile technology landscape analysis below for further operational considerations.</td>
</tr>
<tr>
<td></td>
<td>Designing technology for ideal conditions and tasks rather than imperfect realities will doom a solution to failure. For example, if messages are sent to recipients but the majority of them do not have mobile phones or understand the messaging.</td>
</tr>
<tr>
<td>ECONOMIC</td>
<td>Does the project have the financial resources and staff time to develop, implement and maintain the mHealth project? See the benefits and costs section below for further considerations.</td>
</tr>
<tr>
<td></td>
<td>Underestimating the financial and time requirements can cause projects to skip prerequisite activities and increase project risks.</td>
</tr>
</tbody>
</table>

**Estimate the benefits and costs**

Benefits and costs can be tangible or intangible. Tangible benefits are advantages in measurable units, such as cost savings, increased speed, or decreased staff time. Intangible benefits are difficult to measure or assign a monetary value, such as improved decision making or job satisfaction. Likewise, tangible costs are measurable units such as cost of equipment or time. Intangible costs are difficult to estimate, including changes to organizational culture. The cost section of this guide describes how to estimate monetary costs of mHealth. The comparison of benefits and costs can be documented in a business case for the project. Showing monetary value can increase attractiveness to funders. Determining economic feasibility can inform mHealth design and partnership selection, as well as enable ongoing planning for sustainability.

**Conduct an external landscape analysis of mobile technology**

Investigation of the topics below can indicate whether mobile technology is viable in your area.

- What is the mobile phone market penetration in the country or target area? Break this down by urban/rural, male/female, basic phone/smartphone, and carrier/platform use. How is this projected to change over time? This information can be obtained from GSMA, ITU, local telecom ministries and mobile network operators (MNOs).
- Do intended users currently own phones? Will the project need to purchase phones for users? Or adapt the mHealth design to the phones they currently own? Or will it rely on the phones owned by peer referents?
- What is the cost of a data plan? What is the average monthly mobile phone expense for the proposed target population? What is the average and projected total cost of mobile phone ownership for an individual? What telecom market advances are driving the cost structure for users (for example, network coverage by the MNOs or availability of low-cost devices)?
• How do intended users currently use mobile phone services?
• Who are the key players in the mobile industry, including mobile network operators and telecoms, aggregators, handset manufacturers, regulators and others?
• What kinds of mobile services and functions are prioritized by key players in the mobile industry?
• Explore current mobile industry regulations, policies, and upcoming changes. Do any pose a challenge or advantage to the proposed mHealth solution? This can become a major issue during scale up.

Based on the considerations above, is mHealth feasible and appropriate?

Conduct an internal inventory of computer hardware and ICT systems
Catalogue the type, age, projected life, financial terms and person responsible for relevant equipment and systems.

Create a project charter
Commitment depends on all the considerations discussed in this section. Based on these, document the project objectives, vision, scope and participants. This will inform the formation of a project team.

Form a Multi-Diciplinary Team with Clear Roles

Form a team
Form a multidisciplinary team that can manage every project function, including development, deployment, operations, management and governance. Assembling the right team early is important to reduce later modifications, which can result from “the right person not being in the discussion at the right time.” Identify which resources and skills are needed for each phase, as well as which skills and responsibilities are already available in the Ministry of Health (MOH) or partners.

Numerous groups may be involved in your project. Understanding their various objectives can indicate areas for consensus and collaboration. Common stakeholders and team members are described in table 2 below.

Early coordination with internal ICT staff and mHealth staff can ensure alignment with organizational goals and assets. Internal ICT staff and mHealth staff may be based in country, regionally, or at headquarters. Early involvement of a Ministry of Health (MOH) can increase project alignment with country priorities, ministry ownership of the project, and the sustainability of a project.

Clarify responsibilities
Key project responsibilities include management, development, deployment, operations, monitoring and evaluation, and research:

Management. Project planning, procurement, management, monitoring, and evaluation require a project manager and support staff. Project management may be performed part-time by a staff member, but part-time management requires adequate oversight, controls and risk management. Alternatively, a project may have more than one project manager from the MOH, donor and the IT partner. Multiple project managers require clear roles and responsibilities.
Development. Development, customization or purchase of a software system is a specialized and time-limited role. The development team normally needs external resources, such as IT contractors or technical assistance. The development function is most important in the pilot phase. However, during the scale-up phase, the development team will still need to fix any software problems and accommodate requirements not identified during the pilot phase. Even during the maintenance phase, development work may still be necessary if users require new functions. The skills in this team vary from very technical (such as database administrator) to more analytical (such as business analyst). The business analyst documents current operations and needs/requirements described by the users. The business analyst is a key role and should be experienced in the health domain. The business analyst can be contracted directly by the health organization. Other technical roles may be provided by the IT vendor, including the system analysts, enterprise architect, software engineers, and test specialists.

Deployment. To implement the system at scale, a new set of skills is required, mostly around training, mass deployment or upgrade of computer equipment. This function may also rely on short-term technical assistance. Hardware, telecommunication, and networking services require procurement, deployment, and configuring. The training staff train end users and administrators of the system. For training end users, a training of trainers model can be used. The more complex the application and user interface, the more training is required. Training is a key best practice, which was mentioned as a lesson learned in 7 of the 24 case studies of USAID’s “mHealth Compendium Volume 3” (see resources).

Operations. Once implemented, the system needs to be maintained, and users will need some form of overall support. Operations skills include database management, help desk support, and, if applicable, data center/hosting and system administration.

Research, monitoring and evaluation. There needs to be an individual or team responsible for the measurement framework, documenting indicators and evaluating outcomes.

<table>
<thead>
<tr>
<th>STAKEHOLDERS</th>
<th>OBJECTIVES</th>
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<tbody>
<tr>
<td>MINISTRY OF HEALTH</td>
<td>• Improvements to health system and outcomes.</td>
</tr>
<tr>
<td></td>
<td>• Project implemented on time, within budget.</td>
</tr>
<tr>
<td>MINISTRY OR DEPARTMENT</td>
<td>• Alignment of project with the national eHealth strategy and compliance with policies.</td>
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<tr>
<td></td>
<td>• Ensuring the project leverages existing investments in IT servers, communication networks, etc.</td>
</tr>
<tr>
<td>FUNDER</td>
<td>• Lasting impact and demonstrated value of the project.</td>
</tr>
<tr>
<td>USER/BENEFICIARY</td>
<td>• Delivery of a system that meets their requirements with acceptable usability, performance, and flexibility.</td>
</tr>
<tr>
<td></td>
<td>• Early involvement of the target users can validate a design and facilitate demand.</td>
</tr>
<tr>
<td>PROJECT TEAM</td>
<td>• Meeting criteria set by project sponsors and the funding organization to support health outcomes.</td>
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<tr>
<td></td>
<td>• Meeting user requirements.</td>
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<tr>
<td></td>
<td>• Alignment of country project with organization’s global strategy and technical support for mHealth</td>
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<tr>
<td>SUBCONTRACTORS</td>
<td>• Providing services and receiving payments.</td>
</tr>
<tr>
<td>VENDORS</td>
<td>• Establishment of a long-term revenue stream</td>
</tr>
<tr>
<td>RESEARCHERS</td>
<td>• Determination and publication of evidence-based practices in mHealth.</td>
</tr>
</tbody>
</table>

Table 2: Common Stakeholders
Define User Needs and System Needs

Designing mHealth begins with understanding the needs of the user. The user is the person that uses the mobile device and information. They ultimately control how or whether it is used. It is therefore important to define who are the end users of the proposed mHealth program and how to understand their needs.

Figure 2: Costs of Poor Needs Analysis & Design

Investing in documenting users’ needs and user-centred design saves time and money.

Define the target group or end user

The end user interacts directly with the mobile device. They may be the project beneficiary or a peer. They could be community workers, facility staff, specific segments of the public, or a family member. How will the end users benefit from the mHealth program? What is the best way and how feasible is it to reach the end user with a mobile device?

Conduct formative research

The following points can be addressed by interviews or focus group to understand users’ access, usage habits and beliefs about mobile devices:

- Users’ technology knowledge, adoption and use, and barriers to further uptake
- Ownership of mobile phone and/or access to peers’ phones
- Costs associated with ownership or use, who pays, and their methods of payment
- Use of multiple phones or SIM cards, and changing phone numbers
- Places that mobile phones are used, or not used due to lack of connectivity
- Associations and experiences with the mobile phone
• Mobile phone “literacy” (familiarity) and usage
• Written literacy and languages spoken or read
• Sources and costs for charging phones
• Cultural and gender dynamics around use of and access to mobile devices
• Willingness/ability to pay for mobile services
• Expectations of privacy relating to their mobile phone

During formative research a range of different questions can be introduced to reveal the various needs for intervention design. Some of the questions you may need to answer include:

• Will the application employ one-way, two-way or multi-way interaction between the program and the end user/s?
• Will messages be targeted to specific groups or tailored to individuals?
• How often will messages be sent to or received from users?
• Will the system screen data for accuracy?
• Who registers the user and initiates use? Is it preloaded on phones, registered through intermediaries, or responsive to messages started by the user?
• Are personal privacy, anonymity and data security required?
• Does your system need to interact with multiple mobile network operators (MNO) in order to reach your target audience or reach national scale?

Assign a “business analyst”

Successful design is both a method and a role. The bridging role between programmatic and ICT staff is often filled by a “business analyst”, who analyzes the “business processes” of a project (not necessarily a for-profit “business”). The business analyst ensures that ICT staff and vendors understand and respond to the programmatic needs for mHealth. Ideally, the business analyst would be an eHealth professional with experience in mHealth projects. However, if an eHealth expert is not available, the business analyst can be a public health person who understands ICT or an ICT person who understands public health. The business analyst has the skills and neutral objectivity to document user and system requirements that are transparent, traceable and replicable. In other words, it is transparent why the mHealth system was designed a certain way and who made this decision. Design decisions should also be traceable to requirements, to ensure that technology is aligned with project priorities. Replicable designs are documented in a way that future versions and other projects or countries could replicate the system design.

A design process that is not transparent can cause conflict among staff or partners with differing priorities, particularly without clear understanding of the implications of design choices, or in complex partnerships without clear governance for decision-making. Designs that are not traceable can allow development to accidently drift away from priorities, especially in complex designs requiring multiple revisions. If a design is not replicable, it may require redundant investment in the design process when a mHealth system is later updated or reused in other projects.

Document user needs

The responsibility of a health program manager is not necessarily to understand every technical aspect of technology. A program manager’s first priority is to understand the program’s needs and to clearly communicate those needs. The IT staff or vendor can better explain technology, but they cannot replace the programmatic knowledge of the program manager. Public health staff work with IT technical people such as vendors, developers, consultants, internal IT staff and MOH IT staff. Often, these two groups have completely different backgrounds, cultures and ways of implementation, and even seem to speak different languages. “Host”, “virus”, “case management”, “development” and “business
How to Approach mHealth

“Requirements” are a few terms that have different meanings in public health and IT. This can lead to misunderstanding, which can lead IT partners to make decisions that do not reflect the true needs of public health managers.

As a result, a lack of understanding between the future users of a system and the people who design it is one of the main causes of frustration, delays, cost overruns, and even failures in IT projects. This is especially important in the design stage, because errors are much more expensive and time consuming to fix at later stages, even by an order of magnitude. Methodology to document user requirements can mitigate the risk of misunderstanding and ensure that program managers remain in control of system functionality.

**Describe your activities as processes**

Describing the activities in your health program begins with one of your major activities, which is considered a “process”. A process is a set of tasks that together accomplish a goal or support your program. A detailed process analysis is the starting point to define what the information system is supposed to do. Business processes can be supported by manual as well as automated activities, and by paper-based as well as digital information. Thinking through the process will help you identify the details that are critical for your context.

**Create task flows**

A task flow diagram describes the sub-activities of a process and the people who perform those activities. The task flow provides a “story” for the process. Shared review of the task flows can enable agreement among stakeholders.

**Define requirements**

“Requirements” are a technical form of specifying needs. Requirements specify what is needed to solve a problem or to achieve the objective. Requirements may also be rules required within the IT system.

Functional requirements are usually expressed as statements that begin with, “The system must or should...” They express the functional abilities of a system, for example, the ability to generate a certain report or the ability to keep track of individual patient.

A requirements list can be used:

- To evaluate an existing system (does it comply with the requirements?)
- To communicate requirements to a developer who can find the best way to implement them.
- As a checklist to test a system that was developed.

Nonfunctional requirements often describe the technical and environmental constraints that vendors and developers need to understand, such as the availability of electricity or Internet connectivity in certain areas.

- Requirements have practical uses. Requirements are not abstract needs or theoretical documents.
- For health organizations: requirements describe what technology be developed or selected. Requirements can provide a contractual basis for the technology.
- For project managers: requirements provide a basis for project planning and measuring progress.
- For IT developers: requirements define functionality to be designed and coded
- For testers: requirements provide a basis for testing mHealth.
- For users: requirements inform system documentation and training.
Select the Technology Acquisition Model

Only after the user and system requirements have been documented can technology choices be made. However, this does not begin with selection of specific mHealth applications and tools. First, the mHealth landscape and models for obtaining technology should be considered.

Skipping this step can inadvertently restrict the fit of mHealth with long-term goals, as well as the fit with the overall IT strategies of the larger organization, funder or ministry.

Landscape the mHealth context

Accounting for other applications and projects can save money and achieve greater strategic outcomes through cooperation. Redundant and siloed mHealth projects are common due to lack of awareness or alignment with other applications and projects that are already available.

- **Scan of existing projects:** Are there similar or complementary mHealth solutions that exist in your country or elsewhere? Can projects work together to address long-term goals at the national level?
- **Adapting existing technology:** Can you adopt or adapt existing applications and projects? Will the available application sufficiently serve your own project needs, keeping in mind your documented requirements? Could use of an existing application allow cost savings that could be used on other components of your mHealth project?
- **Linking with other systems:** How will the application achieve interoperability with relevant mHealth applications and health information systems?
- **Data standards:** What data standards are used by the country, relevant partners and actors, or any databases with which the application will provide or receive data?
• Policy environment: What are the current or pending policies of the ministries of health and telecommunications? Does the mobile industry have any regulations, standards or standard operating procedures? Are there any policies regarding data security and privacy?

• Privacy and security: How will data be stored and accessed? Does national policy allow for personal health data to be stored outside the country?

• Local capacity: What is the local technological capacity to support the development, maintenance, and potential growth of the mHealth project? This includes the human capacity, marketplace and infrastructure. What technology partners are available in-country?

Compare acquisition models

Before selecting a specific application, consider the advantages and disadvantages of the different ways to obtain a mHealth system. You can build, buy, or adopt a system. The selection matrix below encourages an objective appraisal of options.

Selecting a model for acquiring an application depends on the fit between the proposed solution and the documented requirements, and the fit within the long-term technology strategy and purchasing plan of the organization and key partners. Total cost of ownership (TCO) of the solution is a key consideration. This includes initial acquisition or development costs, as well as later scale-up and maintenance costs. In this context, the user-friendliness and ease of implementation of the system are crucial. Sophisticated systems with many features may appear cutting-edge, but implementing them may be costly and require intensive training. Organizational capacity is another key consideration. If your organization needs to strengthen its technology capacity, some options include: hiring staff with appropriate technology experience, funding professional development for current staff, or hiring a short-term consultant to supplement and train existing staff.
<table>
<thead>
<tr>
<th>MODEL</th>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom-developed:</td>
<td>Control design to serve specialized needs.</td>
<td>Initially requires more time and budget.</td>
</tr>
<tr>
<td>application built from scratch</td>
<td>Development fosters innovative capacity, sustainable ownership.</td>
<td>Need development team.</td>
</tr>
<tr>
<td></td>
<td>Able to engage local IT industry.</td>
<td>Depends on availability of long-term support.</td>
</tr>
<tr>
<td>Commercial off-the shelf:</td>
<td>Short time from selection to implementation.</td>
<td>May not fit project needs.</td>
</tr>
<tr>
<td>a commercially available product</td>
<td>Able to evaluate before buying.</td>
<td>May be expensive or have complex fee structure.</td>
</tr>
<tr>
<td></td>
<td>App is maintained and upgraded (at a cost).</td>
<td>May not be designed for low-resource environment.</td>
</tr>
<tr>
<td>Free prepackaged:</td>
<td>Shorter lead time.</td>
<td>May lack accompanying IT support and warranty.</td>
</tr>
<tr>
<td>app developed by donor, university or other project or country</td>
<td>Able to evaluate before buying.</td>
<td>Hidden implementation and maintenance costs.</td>
</tr>
<tr>
<td></td>
<td>Less upfront costs, but costs to customize and maintain.</td>
<td>May not be suitable for or adaptable to project needs.</td>
</tr>
<tr>
<td>Open source:</td>
<td>Lower development costs.</td>
<td>Product may not be supported.</td>
</tr>
<tr>
<td>source code and software freely available</td>
<td>Able to adapt software.</td>
<td>Open source community may be too fragmented to rely on.</td>
</tr>
<tr>
<td></td>
<td>Able to engage local IT industry.</td>
<td>Hidden implementation and maintenance costs.</td>
</tr>
<tr>
<td></td>
<td>Benefit from open source communities, if available.</td>
<td></td>
</tr>
<tr>
<td>Software as a Service (SaaS):</td>
<td>Easy to implement, maintain.</td>
<td>Data hosted on remote servers, which may conflict with privacy or policy.</td>
</tr>
<tr>
<td>hosted on a remote server and provided in increments.</td>
<td>Clear cost structure.</td>
<td>MOH may not be able to take over regular fee.</td>
</tr>
<tr>
<td></td>
<td>Upgrades can be shared easily (maybe at a cost.)</td>
<td>May not be suitable for or adaptable to project needs.</td>
</tr>
</tbody>
</table>
Select the Technology Vendor

If you choose to externally acquire an application, it is easy to be overwhelmed by vendors with more experience in mHealth. As with contracting any vendor, the competitive process involves a team selection according to relevant criteria. However, selecting mHealth solutions can introduce new criteria and questions. This step helps you to ask the right questions when selecting a vendor.

Issue a request for proposal

A vendor can be found by issuing a request for proposal (RFP). The previous functional and nonfunctional requirements seen above are good elements to communicate what you expect in an RFP. The RFP should also explain how you will evaluate proposals. If you will select multiple vendors, it is important to be clear on how they will work together. A good practice is to ask one vendor to take the overall lead and responsibility, and subcontract with other vendors.

At a minimum, the RFP should state that proposals must include:

• A description of the proposed application;
• A description of how the application will be implemented in your context;
• An implementation work plan with timeline, methodology, roles, and responsibilities;
• Specification of vendor responsibilities for hardware support, software support, installation and training, maintenance, data storage, web hosting and upgrades;
• The technical and organizational capabilities of the vendor, highlighting past projects that are most relevant for this work; and
• The cost and level of effort, including the effort required from MOH staff.

Evaluate each proposal

A multi-disciplinary team should screen submissions before finance or procurement staff evaluate them in-depth. This expertise should include subject matter experts in the health domain, system architecture, business analysis, project management, software development, procurement, and senior management. The procurement committee is responsible for evaluating proposals based on the evaluation criteria outlined in the RFP. As with any RFP process, a small set of proposals can be selected for vendor demonstrations and in-person interviews.

Suggested selection criteria:

• The proposal communicates an accurate understanding of the documented user requirements and project goals.
• The proposed technical solution is feasible for the expected environment, users and organizational capacity.
• The proposed technical solution is complete, addressing all the requirements outlined in the request for proposal.
• The proposal presents a logical system of when and where different modes of communication technology will be used (SMS vs versus wired Internet, etc.).
• The proposal proactively identifies challenges and possible responses.
• The proposed work plan fits within the expected timeline and includes sufficient time for project requirements definition and design, testing, feedback, and iterative development.
• The proposed system development methodology is compatible with the management and contractual style of the health organization. Will a structured or agile development...
When considering proposed solutions, consider the following:

<table>
<thead>
<tr>
<th>Requirements</th>
<th>How well does the system meet the user needs?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalability</td>
<td>Has the system been tested or implemented at the scale necessary?</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Can the system be easily maintained and adapted as organizational needs change?</td>
</tr>
<tr>
<td>User Fit</td>
<td>Does the system fit well within the existing culture, language, and user workflows? Does it reduce workload or add burden for users?</td>
</tr>
<tr>
<td>Costs</td>
<td>Are the costs of implementation and operations within funding constraints?</td>
</tr>
<tr>
<td>Timeline</td>
<td>Can the system be implemented within the expected time frame?</td>
</tr>
<tr>
<td>Licensing and Contracting</td>
<td>How well does the system fit the procurement guidelines for intellectual property and use of local resources?</td>
</tr>
</tbody>
</table>
methodology be used?

- The proposed methodology reflects an approach of high communication with the commissioning organization and users.
- The proposal reflects the requirements stated in the request for proposal related to warranty, pilot support, and maintenance contracts.
- The proposal reflects the requirements stated in the RFP related to warranty, pilot support, and maintenance contracts.
- Programming and computing capabilities (with required architecture, languages, and tools) are evident.
- The proposal refers to previous work that is relevant to our project methods and goals.
- The proposal contains guarantees for documentation, maintenance, warranty and ownership transfer.
- Sufficient staff are proposed who have appropriate skills and experience.
- The proposal demonstrates that the vendor has experience working with organizations similar to yours.

Suggested questions to ask potential vendors:

- What is your largest IT implementation?
- How many users can use the system at the same time?
- What components of the proposed platform are proprietary?
- How much uptime do you guarantee each month? For how long is the system unavailable each month for maintenance?
- How would you integrate with other applications or health information systems?
- How is the security and privacy of data ensured?
- How often is data backed up? What are disaster recovery plans?
- What training and support services is provided or needed? What hours is support available?
- What are the current and projected fees for maintenance and licensing?

There are many modes for messages and data (SMS, IVR, USSD, GPRS/Internet, etc.) Preferences for each may change, and choices are best made in cooperation with an IT partner. However, format selection may be necessary when choosing an acquisition model and before selecting an IT vendor. This is because some available applications or vendors only operate in certain formats. Format preferences may be evident in user needs and defined requirements. These considerations are discussed further below in selecting a data service.

Evaluate the costs of screened proposals and select a vendor

Total costs of ownership is discussed on further below under costs. Costs include contracting costs for this vendor, as well as any implication on the overall lifecycle costs of the system. It may be justified to select a proposal or system with a higher upfront cost if the maintenance costs are expected to be lower, if the solution is technically superior, or if the delivery date is more favorable.

Draft a contract or memorandum of understanding

As with any agreement, this should stipulate deliverables, timelines and change fees or penalties. The contract should also deal with licensing (who will own the system, including the software code?) and service after the project (until when will the company be required to fix bugs with no extra payment).
Design System Information Flow

This activity focuses on diagramming the information or data that is flowing into and out of the system, as well as the processing of the data. This will help determine the scope of the system. What is to be included in the system and what external entities are outside the scope of the system? What external information sources will be connected to the system?

Use cases can help identify the data entities. Then determine which data the system will (C)reate, (R)ead, (U)pdate and/or (D)elete data (CRUD). Based on this, the data requirements are defined to support the system. Then design the structure of your database and data tables. Data design should ensure data integrity, consistency and avoidance of redundancy. IT staff or information system staff may be helpful with these issues, which are common for any database.

Determination of data flow and requirements can influence many considerations.

- What is needed on the device to exchange information with the user?
- How is information transmitted?
- How is the user identified and provided access?
- How is the data managed, warehoused, shared and analyzed?

Many of these activities would be discussed more fully by IT partners. These issues are introduced to prompt health organizations to discuss their needs more fully with any partner.

Select Mobile Data Service and Devices

If the project communicates through user-owned devices, then the mHealth solution must be designed to operate on their devices. If the project is providing devices to users, device selection should be informed and preceded by the activities above. Accepting donated or discounted devices without the preceding planning may commit the project to devices that do not serve the needs of the project or users.

Select a data service

Beyond voice, information can be transmitted delivered through various types of data services or protocols, such as short message service and general packet radio service. These can vary in availability and transmission speeds, and can affect costs and user interfaces.

Table 4: Data Service Considerations

<table>
<thead>
<tr>
<th>DATA SERVICE</th>
<th>CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short message service (SMS)</td>
<td>• Available on almost all phones. No software installation required on phones.</td>
</tr>
<tr>
<td></td>
<td>• Sends a “short message” with low data volume typically limited 160 characters.</td>
</tr>
<tr>
<td></td>
<td>• Requires mobile broadcast coverage but not Internet access.</td>
</tr>
<tr>
<td>General packet radio service (GPRS)</td>
<td>• Accessible on Java-enabled feature phones or smartphones.</td>
</tr>
<tr>
<td></td>
<td>• Delivers large volumes of data at a higher speed than SMS.</td>
</tr>
<tr>
<td></td>
<td>• Delivers multimedia data (e.g., photos).</td>
</tr>
<tr>
<td></td>
<td>• GPRS data is submitted directly to your server over the Internet.</td>
</tr>
<tr>
<td></td>
<td>• Data can be stored on forms for asynchronous transmission later when connectivity is available.</td>
</tr>
</tbody>
</table>
Select devices

When selecting which devices to use, take into consideration:

**Access to data service.** Devices vary in the types of data service in which they can transmit. As discussed above, these can vary in terms of upload times and rates of data transmission. This can affect costs, content development and user interface, as discussed in later sections.

**User needs and preferences.** What is appropriate for the intended user? This can be influenced by previous experience with phones, literacy, age and eyesight. If introducing sophisticated phones to new users, would training be necessary? Do users have preferences for types of devices or related functionality? This can determine the message format – voice, text, data or video, which can influence network requirements- 2G, 3G, GSM or CDMA, etc.

**Operating system.** Is the phone’s operating system compatible with the information systems with which it will interact? Is the operating system used in other related projects and will IT support be available for it?

- Number of phones needed. How many phones will be needed for development, user testing, piloting and scale up? How does this affect selection criteria for costs and reliable availability of phones?
- Availability in-country:
  - Local phones are preconfigured for the right fonts/character set, dates, voltages, and plugs needed in-country.
  - In case of theft or damage, there should be a reasonably fast and efficient way to get a replacement.
  - Availability of local servicing outlets can address device damage and repair.
- If not sourcing locally:
  - Unlocked phones are preferred since many phones get locked into particular network providers.
  - Correct frequency band for the country of deployment.

**Accessories.** These might include SD card, SIM cards, solar chargers, extra batteries, extra chargers (if poor quality grid electricity), plug adapters (if sourced from somewhere with different plugs), locks or boxes to prevent theft (if phone is attached to a facility), engraver to label devices (to prevent theft).

**Cost.** In addition to the costs of phones and accessories, costs can vary on phone SIM cards, monthly fees, modes of transmission, and related data uploads and airtime.

**Battery life.** This is particularly important for working in rural areas where access to power can be infrequent or expensive.

**Longevity.** Will the model still be available in-country in five years?

**Likelihood of theft.** Is the phone similar to others in the region or will it attract attention as an expensive phone?

**Durability.** How easy is it to break the phone? Phones with moving parts that physically flip or slide may break more easily. What are the environmental threats (e.g. rain, dust, insects)?

**Speed and memory.** Will data storage, applications and calculations be performed on the phone or transmitted for completion at another location? Will speed or storage limitations affect performance, use or workflows?
Screen size and resolution. Will the device be used briefly to read short messages or extensively for long and complex forms? Larger screens may be easier to read and more flexible for navigating user interfaces. These “form factors” can affect content development and user interface in the next sections.

Keyboard size. Will the device be used occasional entry of brief information or extensively for long forms? Larger keyboards can be easier to enter lengthy, qualitative information. This may depend on data requirements.

Features (e.g. camera, mapping GPS). Features can allow capture and sharing of other types of information (e.g. photos). This can affect the needs for modes of transmission above.

Develop or Adapt Content

The discussed steps of formative research, user-centered design and device selection can inform content development. Content should align with user needs. For instance, do users prefer text or voice? Content should also be adapted to the device screen or transmission mode. For instance, how many characters can fit in the screen or SMS message, or how many menu options can be developed for interactive voice recording (IVR)?

Content development should follow the same best practices used for content in any format. Adapted content should be vetted with appropriate technical experts and government counterparts. For practical concerns, Microsoft Word can SMS content with the “word count” function. Since content will be revised in repeated version, a naming convention can support version control.

Mobile Alliance for Maternal Action (MAMA), CommCare and other mHealth content repositories share content for adaptation by other programs, reuse of content can reduce costs and redundancy of efforts. But this can be balanced with content tailored to local needs and local approvals.
Conduct User-Centered Design and Testing

Employ “user centered design”

Like patient-centric design, the process for developing and testing a mHealth application should center around the user. This draws on the formative research discussed previously.

Principles of user centered design

- Focus on users and tasks
- Structured and systematic information gathering
- Trained designers conduct information gathering
- Empirical measurement and testing of product usage
  - Focus on ease of learning and ease of use
  - Test prototypes with actual users
- Iterative Design
  - Product designed, modified and tested repeatedly
  - Allow for significant redesign by early testing of design

The user-centered approach begins earlier in defining requirements and extends through content development. It again becomes important in designing and testing user interfaces.

Failing to fulfill user needs can lead to disuse of an application that users reject. Many projects rely on novelty and enthusiasm for technology to drive use of an application. This is a common mistake, since many test subjects like anything new on a free phone. Yet this novelty can fade, decreasing use of the application if it is not designed to meet users’ long-term needs.

Test performance of the solution

This is a test of whether the solution functions as intended. Clear documentation of requirements in earlier stages enables this test to be objective. The test should verify compliance with functional requirements (e.g. accept a query and provide a confirmation of submission), as well as nonfunctional requirements (e.g. route 100 messages within 1 second).

Design and test usability

Usability covers the experience of actually using the mHealth application. ISO 9241-11 expands the definition of usability as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.” Lack of usability can deter use of an application, so usability can be particularly important for users with low “mobile literacy” (low familiarity), difficult workloads, or low levels of accountability and supervision within a project. It is important to remember that a solution can have multiple types of users, including beneficiaries, staff, supervisors, project managers and evaluators.

In software development for computers, usability testing is often postponed until late in the development process. For mobile devices, however, usability should be prototyped and tested early in development. This is because the small screen on mobile devices and their unfamiliar use for health can impede usability. It would be a waste of resources to spend an extended time developing a mHealth application, only to find out late that it is illegible or unworkable for users. To circumvent this mistake, mock prototypes or “wire frames” can be used to pretest usability before investing heavily in development. As stated above in the principles of user-centered design, the application should be tested with intended users. Users should have the opportunity to express what about the application they like.
and dislike, and what is understandable or confusing. However, usability means more than to “like” a solution.

Usability objectives include:

- **Usefulness.** Enable the user to achieve their goals, tasks and wants (each of which may be different.)
- **Ease of use.** Simple and consistent displays prevent confusion. Speed and error rates of use are measured quantitatively.
- **Learnability.** User’s ability to operate the application to a defined level of competence after a predetermined period of training. This also refers to the ability of infrequent users to relearn the application.
- **Attitude/likeability.** User’s perceptions, feelings and opinions of the product.

These objectives can inform the screen format or user interface of the mobile application. They can also influence what information is exchanged with the user. To support usability, systems should provide feedback to users. This can include acknowledging acceptance of input, acknowledging completion of a process, and explaining input errors or processing delays.

Usability should be tested under realistic conditions, such as incomplete broadcast coverage, low battery life, and sharing of the mobile device. It is important to observe how users respond when the solution faces challenges or does not function as intended.

### Develop Partnerships

Potential partners may include those that were earlier considered in the mHealth landscape but not included in the mHealth team. As the project nears implementation, there should be renewed consideration of whose support or buy-in would help implement, promote, maintain, scale and sustain the project. Implementation of mHealth can involve nontraditional actors. Who are the relevant actors in the mHealth space? In addition to traditional partners like NGOs, MOH officials, policy makers, and funders, it could also include technology partners, mobile network operators (MNOs), and technology entrepreneurs, incubators and hubs. Early discussion of partner expectations can reduce unplanned redesign, though partnerships should be flexible to adapt with the iterative development process. As with any partnerships, the capacity, priorities and clear roles of partners are important. The roles and partners may evolve as the project evolves through implementation, scale up and sustainability.

### Estimate Costs

Understanding costs is important for allocating necessary resources to a project. However, costs vary among mHealth projects, as with any projects. This section addresses some of the general questions about cost. How much will this information system cost to develop, scale, and sustain? What are the individual major cost categories and the variables that drive these costs? How do you budget for support and maintenance?

#### Calculate the total cost of ownership (TCO)

The TCO includes not just the initial investment, but also the costs to scale and sustain the system over three to five years after implementation. Looking at the TCO helps to determine investments. For example, an initial investment in improved usability may reduce long-term training and support costs.

Technology deployment can include the following as part of TCO:

- Computer hardware and programs
- Network hardware and software
How to Approach mHealth

- Server hardware and software
- Workstation hardware and software
- Installation and integration of hardware and software
- Warranties and licenses
- Licenses
- Data migration expenses
- Operation expenses
- Infrastructure (floor space)
- Electricity (for related equipment, cooling, backup power)
- Testing costs
- Downtime, outage and failure expenses
- Diminished performance (i.e. users having to wait, diminished money-making ability)
- Security (including breaches, loss of reputation, recovery and prevention)
- Backup and recovery process
- Technology training
- Audit (internal and external)
- Insurance
- Information technology personnel
- Management time
- Long term expenses
- Replacement
- Future upgrade or scalability expenses
- Decommissioning

Cost structures vary by stage. During different phases of the project, from development to deployment and operational support, the spending on various cost categories changes:

- **Pilot**: Solution development or adaptation is the primary cost in this stage. Costs depend on the functional, technical, and organizational complexity of the project. These may not be unit costs and may not vary significantly for a large or a small country.

- **Scale up**: Unit costs and total costs are typically highest in this stage. The number of future users and the cost per user to deploy it are the most important variables. The cost per user depends on the way in which users will access the system (for example, desktop computer, mobile phone, paper) and their training needs.

- **Sustain**: In addition to the number of users, the selected technology is key. For example, any solution that requires local software installation and maintenance will be more expensive than a centralized system, such as a web-based or cloud system.

Analysis of costs should consider the following scenarios related to mHealth:

- Increased use of health services or products.
- Integrated systems and platforms versus standalone mHealth solutions.
- Shared services with other mobile solutions in health or other sectors.
- Effect of mHealth on human resource costs.

Costs should be documented and modelled realistically. Comparative costs can be calculated based on cost per unit of activity, such as cost per message exposure, per record access, per survey completion, or per health worker visit. Cost savings and productivity increases should also be measured and documented. Depending on the type of mHealth and area of the health system, potential areas for cost savings and improved efficiency are saved time, reduced transportation, decreased clinic visit, or skipping redundant data entry.

**Develop an Implementation Plan**
Both costs and time are often underestimated in implementing a mHealth project. This sometimes leads to incomplete analysis of needs, unclear documentation of requirements and scope, and lack of quality controls or risk management. This can result in delays and cost overruns. Having a plan and following a project methodology is the key to ensuring success. This step highlights some attention points.

Write a work plan

Work plans ensure that adequate time and accountability is allocated for activities. This can be finalized with partners and may include the following key activities:

- Identify team members (coordination with external stakeholders can take months).
- Specify requirements (this crucial step can take at least a month, not including time for formative research).
- Build and test prototypes.
- Develop software (technology development, content localization, and acquiring mobile short codes can take many months. Prepackaged solutions, onsite and “collocated” IT teams, and strong IT partnerships can reduce development time.)
- Procure equipment.
- Train key staff.
- Adapt to feedback.
- Finalize application and training materials.
- Train users.
- Deploy solution.
- Monitor and analyze solution data.

Monitor milestones

Completion of each milestone represents a period for review and quality control. Senior leaders should participate in regularly scheduled meetings to review project milestones.

Requirements definition

Organizational approval of requirements is an important step in ensuring that they serve the needs of the project and users. It is the ultimate responsibility of the health organization to ensure that requirements are accurate.

Test

User and Performance testing. As discussed in the prior section, user testing and performance tests ensure the technology is relevant and sufficient before spending significantly on deployment. This can initially takes place in a controlled central setting, with test data. (Sometimes this is referred to as a “conference room pilot.”)

Pilot testing. A pilot test in a real-life setting in which a limited number of real users work with the system, entering real data and following their normal procedures and habits as much as possible.

Volume (stress) testing. A volume or stress test, in which a large number of users enter a large number of transactions to ensure the system is fit for a larger scale.
Beyond the large milestones, work plans should be realistic about practical details. Will the project purchase phones for the end users? How much lead time is needed to order the phones or to conduct them through customs? Where will the phones be stored before they are handed out? Will the phones need to be charged before they are distributed? How will they be charged in the field? How will mHealth trainings fit into schedules of other trainings? If staff are going to be accountable for complying with the work plan, they should ensure that it is realistic.

**Prepare for Rollout**

**Generate demand**

Demand generation raises awareness, interest, and understanding of the mHealth project and its benefits. Early and ongoing involvement of stakeholders and beneficiaries can foster buy-in among potential users and gatekeepers. Promotion of mHealth can emphasize its usefulness to audience and user segments.

**Prepare documentation**

System documentation supports system management by implementation staff and supports adoption by users. This can take the form of project protocols or a user’s manual. Staff should begin capturing content early in the project. In addition to technical descriptions, documentation should describe the development and implementation processes.

**Conduct training**

Training enables users to employ the solution. Procedural guidelines and orientation for new staff should be updated. Users and others who will be affected by the changes should have the opportunity to ask questions and express concerns.

A graduated release through “soft launch” or “beta launch” before the actual large-scale launch of the mHealth program may help to identify and resolve any remaining issues before the program is released to the wider public.

This may avoid large-scale problems that could ruin a project. Traditional non-technology practices may be initially maintained in parallel with the mHealth deployment meant to replace them. This can reduce risk until the project is stabilized, but place redundant burden on users.

**Manage the Project**

Ongoing management of a mHealth project involves many standard responsibilities and some new ones.

- Have organizational policies and procedures been updated to support the mHealth program?
- Have staff members and/or users been trained, and will refresher training be provided?
- What kind of system has been put in place for regular communication between the technological partners, other partners, and the implementing health organization?
- How will the project team members keep each other accountable to the work plan, timeline and budget?
- Is supportive supervision in place to help staff implement and manage the change in practice? Have supervisors received training not only on the technology and content of the mHealth application but also on how to manage staff challenges that arise during implementation?
Introduction to mHealth

• How will the effect of the mHealth solution on staff workload and workplace procedure be monitored?
• Does the mHealth solution comply with the enabling environment, and operate well within existing solutions? If new systems are needed, how will the project manager be involved in developing them?

Project managers must also manage the data generated by users of the mHealth application. This includes ensuring the data is collected in a way that provides insightful information for program staff, donors, and decision makers, while maintaining the privacy and security of users. IT systems introduce the need to monitor system data in real-time or “near-time” throughout implementation to see if intermediate outcomes are being met and whether the intervention is likely to meet its goals. Qualitative data collection beyond the digital data can allow troubleshooting beyond the information provided by monitoring digital data.

Foresee Risks

Following the steps described previously should lower project risk by aligning requirements to organizational objectives, understanding costs, planning appropriately, and choosing the right vendors and partners. However, introducing innovations involves risk. This section addresses critical factors for project failure and how can project risk be managed.

Common risk factors:

• **Lack of governance.** Passive participation or inadequate representation by senior leadership can impede project success. This can take various forms, such as lack of a project champion from upper management, misalignment of partners’ objectives and stakes, unreliable external partners, or organizational instability.

• **Poor management.** Limited technical capacity, allocated time or organizational authority can undermine management. This can be caused by staff turnover, incomplete skills, unclear roles, project complexity, scope creep and inadequate resources.

• The **implementation issues** mentioned earlier in the guide are risks, including quality of design, narrow technological approach to ICT, changes in communication patterns, changes in the power structure, modifications to planned implementation costs, organizational capacity, and government commitment and capacity.
Monitor and Evaluate (M&E)

The use of mHealth should be assessed by monitoring and evaluation. Innovative interventions have particular need for M&E to ensure attainment of and alignment with project goals. Evidence can also provide a justification of investment in technology and scale up.

Many standard M&E methods and indicators can be used for mHealth. However, mHealth can introduce new considerations for monitoring and evaluation.

- **Indicators**: Introduction of new steps in mHealth development can require monitoring of new process indicators. Many of the activities in this guide may be new to projects, and completion of activities should be monitored. Monitoring fulfillment of mHealth activities can prevent unintended lapses or identify causes of poor performance. Likewise, indicators can be developed and monitored for the relevant risks that are mentioned in this guide or identified by the project.

- **Implementation challenges**: Use of innovative approaches can encounter unforeseen complications. Have there been unexpected modifications to design or delays in implementation? Were these occurrences and their reasons documented?

- **Target reach**: The delivery of content and data should not be taken for granted, particularly with low-resource environments, rural areas with low connectivity, or low-income populations with limited access to technology. What percentage of the target population or users are able to interact with the mHealth system? What percentage of time is the system nonoperational? What percentage of messages or data is received within time requirements?
System and usage data are generated and recorded by mHealth systems, often in great volumes. Key indicators and types of data should be identified in advance to avoid information overload among project managers. The real-time or “near-time” availability of raw data may also create information overload. Such information overload can be alleviated by building analytics into dashboards with visual formats for presenting data.

Monitoring of mHealth programs can be continuous through system and usage data. This can allow ongoing refinement of the mHealth project. However, implementation or updates cannot be postponed indefinitely due to ongoing data generation. As such, major revisions can occur at scheduled stages.

Even when the principal purpose of mHealth is an intervention tool, it may also be used as an M&E tool for that intervention. Digital surveys can be sent to users to query the effects of mHealth.

Use of system data and mobile data collection to monitor and evaluate a mobile project may introduce bias. Evaluations depend on the quality of data, yet the quality of data depends on the mHealth system. How do you know if mHealth has no problems, or if flaws in the system prevent reporting of problems? Consequently, evaluations can benefit from mixed methods using multiple data sources. Active troubleshooting visits to users can help identify unreported issues.

mHealth may not have a direct impact on health. This is because mHealth often supports project interventions, rather than a direct health intervention. mHealth delivers information, but does not directly deliver commodities or treatment. Instead, mHealth can support the delivery of proven health interventions, which in turn, can have health impact. For example, use of mHealth for data collection may not directly impact patients, but may improve a program’s ability to serve patients. Thus, the effect of mHealth may be an intermediary outcome of the quality, speed, cost, reach or volume of the health intervention supported by mHealth.

Likewise, mHealth is not a stand-alone project, but technologies that are integrated within programs. Thus, mHealth may be measured by its effect upon the program, rather than its standalone impact.

In addition to standard M&E indicators, there are general criteria for evaluating information systems. The Information System Utility Approach evaluates each component of technology according to the following criteria.

- **Possession utility.** Are intended users and system managers receiving the correct information from the system? Does the information enable them to either improve health outcomes or improve the mHealth project?
- **Form utility.** Is the information organized to support meaningful decisions? Is it difficult for the user to understand or analyze the information?
- **Place utility.** Does the system distribute information to the place where decisions are made?
- **Time utility.** Is information delivered at the appropriate time, before decisions are made, but not too soon to be accurate or relevant?
- **Actualization utility.** Is the information actionable and utilized? Is there sustained use of the information?
- **Goal utility.** Does the information system serve the priorities of the organization?
Implement Scale Up

The decision whether to scale up the mHealth project is based on evaluation and related refinements. Scale up should include the following steps and considerations.

Consider sustainability and scalability of the program from the beginning. Technology should be able to perform at scale within reasonable costs. This should be accompanied by long-term plans for financing and for local ownership.

Reassess the user requirements

Reassess the user requirements for new users, new geographic areas and new health areas served. As mHealth is scaled, new requirements may be introduced or new demands may arise to justify added investment.

Landscape existing similar mHealth efforts

Scale up may bring overlaps with mHealth projects in the expanded area. This introduces opportunities for knowledge exchange, as well as shared platforms or IT support to reduce costs. Parallel operation of similar mHealth projects for the same area and population also introduce needs for cooperation to avoid redundancy, as well as needs for interoperability to avoid data silos.

Form partnerships to support scale-up

New partners may be required to provide resources at scale or reach into new geographic areas.

Align with national health priorities and health information systems

Compatibility with existing priorities and systems will increase relevance at the national level and buy-in among national decision makers.

Scaling up mHealth and health ICT should address numerous key concepts.

- **High Level Leadership.** Leadership can combine the perspective and influence of government, implementers and donors. Governments have a leading role in determining national policies and regulations for ICT.

- **Alignment with Health Goals.** Align mHealth with the strategic goals and priority interventions of national and provincial health departments.

- **Alignment with Partners.** National ownership is defined, designed and delivered primarily by national stakeholders. It also includes alignment with and between funding sources.

- **Cultural and Institutional Context.** The contextual understanding can include local content creation, local language used, and content related to the local situation.

- **Simplicity.** Simple design may be necessitated by low levels of education, limited training costs, lack of resources, and lack of dedicated time to use the system.

- **Usability.** Greater usability requires less training, and training obligations can slow scale up.

- **Robustness.** Compatibility with a low resource environment can depend on the reliability of an electrical power supply, phone transmission, the resources to pay related bills, and comfort with routine use.

- **Flexibility.** This relates to the ability to adapt improvements and innovation as organizational challenges and needs evolve. This includes flexibility to accommodate change, as well as flexibility to accomplish a range of tasks.

To avoid your project stagnating as a small pilot, plan for the sustainability and scalability of the program from the beginning.
• **Standards and Interoperability.** This determines the ability of solutions to share information with each other, increasing the usefulness of each. mHealth solutions can be integrated with a breadth of electronic data sources, permitting data to be shared across projects by many types of users. Interoperability is design based on standards, which exist for architectures, data interchange and semantic content or types of health indicators. IT partners can design mHealth for interoperability if it is requested by the health organization client.

• **Evaluation.** Testing should be conducted under routine operating conditions with existing resource constraints. Beyond the intervention itself, it is important to assess and document the process by which intervention is implemented.

• **Knowledge Sharing.** Information sharing can facilitate replication elsewhere, promote collaboration and inform decision making.

• **Management.** Assigned teams and staff backup for key functions can support management.

• **Capacity.** Implementation capacity includes organizational readiness and mechanisms for implementation, support, monitoring and evaluation.

• **Pace of Scale Up.** Quick development for field testing allows a lightweight solution, while software built for scale requires investment in a system backbone.

• **Demand.** Educating and engaging end users and target beneficiaries throughout mHealth development can encourage buy-in.

• **Cost and Cost Effectiveness.** Many ICT costs are higher in developing countries, but can be offset by reuse and collective bargaining.
Plan for Sustainability

Sustainability planning is an ongoing process that should begin early in feasibility planning to preposition the mHealth solution and partners. Sustainability can depend on financial resources and local capacity and ownership.

- Implementation costs should be tracked and used to estimate costs of scale-up and potential cost savings of the program.
- Long-term operating costs should be considered when making early project decisions. The “break even” point of technology investments and replacement can vary for hardware, software development, use of open source software, and version updates.
- Local capacity can be developed and deployed to deliver mHealth services and develop, maintain, and upgrade mHealth systems.
- In-country partners can be sought to operate the system to extend operation of a mHealth system beyond the duration of a project. This introduces questions for who “owns” (and operates and funds) the mHealth system and intellectual property in-country or elsewhere. Transition to in-country partners can be supported by documentation of project protocols and training of partner staff.
- Selection of new partners (leadership and governance, financial management, human resources, and organizational performance, financial stability, management).
- Transitioning ownership to a ministry of health may require capacity building and creation or sponsorship of new staff within the ministry.
- Public-private partnerships provide another type of opportunity for financial sustainability. Social entrepreneurs and social enterprises can provide financial sustainability, local capacity and local ownership, sometimes at low cost. Large companies can provide sophisticated product development processes and project management, breadth of experience, quality products, scalability and access to resources. Private companies appreciate public health organizations with relevant expertise, reach and reputation.
- Revenue generation can support financial sustainability. Technology introduces new opportunities for revenue models for public and private organizations. These opportunities can raise additional questions:
  - Is your organization suited to generating revenue or partnering with for-profit entities?
  - Who will pay for a mHealth product or service? Health payers often include individuals, states or NGOs. Other potential payers include consumers, health service and care providers, insurance companies, medical suppliers, employers, mobile network operators or mobile service providers.
  - Who has willingness to pay, available budgets, a fit with target populations and a fit within the continuum of prevention and care?
  - What is the demonstrable value in terms relevant to the decision maker, whether the value is financial, health impact or otherwise?
  - How are the financial outcomes aligned with the health outcomes?

Barriers to sustainability can include:

- Donor timelines can limit the time to research and design mHealth. Funding often runs out before the intervention can be scaled or before cost savings can be realized.
- Lack of coordination has led to many pilot projects that lack interoperability with existing systems and are unable to continue or expand.
9. Conclusion

Many new opportunities are introduced by mHealth to support traditional practices and areas of public health. Likewise, mHealth relies on many traditional approaches of program design, management and evaluation. But mHealth also introduces new risks, and new processes needed to reduce these risks. New types of partners and new costs are balanced by new planning activities to enable the advantages of mHealth. A methodical approach to mHealth implementation can ensure the relevance and long-term success of your project.
# Key Resources for mHealth

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MATCH MAKING SERVICE
We link up health implementers with individuals or organisations with the right skills and experience.

NEUTRAL
We are not linked to any service provider so can give straight forward recommendations.

QUALITY ASSURANCE
All our experts are carefully vetted and projects are overseen and evaluated to ensure the best quality results.

EXPERT NETWORK
There are over 50 carefully vetted mHealth experts in our network from around the world.
About mHELP

The mHealth Expert Learning Program (mHELP) provides support and technical assistance to individuals, governments, the private sector, and non-governmental organizations in low- and middle-income countries that wish to implement electronic health (eHealth) and mobile health (mHealth) into their health programs.

With an extensive database of vetted mHealth consultants, mHELP is a global, neutral partner that can deploy experts across the globe to support mHealth initiatives of all types.

Focused on improving reproductive health, maternal, newborn and child health, and HIV and AIDS, mHELP offers a range of services designed to build capacity and strengthen implementation. These include:
• advice for small projects and queries,
• guides and resources,
• needs assessments and specification development,
• training courses, and
• consultancies on all aspects of mHealth.

To get mHealth advice or support, including assistance in setting up a messaging system or selecting a service provider, please visit www.mhelp.org or send an email to info@mhelp.org.
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