Original Article

Use of short message service for monitoring Zika-related behaviors in four Latin American countries: lessons learned from the field

E. 'Kuor Kumoji, Saifra Khan Sohail

Center for Communication Programs, Research and Evaluation, Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

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Correspondence to: E. 'Kuor Kumoji, DrPH, MPH, MS. Senior Technical Advisor, Center for Communication Programs, Research and Evaluation, Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, 111 Market Place, Suite 301, Baltimore, MD 21201, USA. Email: KuorKumoji@jhu.edu.

Background: Effective response to widespread epidemics relies in part on rapidly changing information from affected communities as individuals react to emergency response efforts. The short message service (SMS) approach was used to monitor knowledge, prevention, and behavior during an outbreak of Zika cases in Honduras, El Salvador, the Dominican Republic, and Guatemala in 2017. SMS methods supported collection of monitoring data at a time of heightened reliance on communication via mobile phones, and when the use of phones for epidemic-related communication was amplified. SMS methods were used to collect monitoring data on knowledge of Zika risk and prevention, and behaviors to prevent Zika infection.

Methods: Serial SMS surveys were conducted over a seven-month period to capture changing community perceptions of risk and behaviors to prevent Zika during the epidemic. This article discusses the development of the SMS surveys, from planning and designing tools to collecting the data, and the unique experiences encountered during survey implementation.

Results: Special considerations for the effective use of SMS for data collection are described, including market penetration of mobile phones, predominant phone types in use, preparation of communities and the target audience, options for tailoring questionnaires to the available technology, relationships with telecommunication companies, and supporting participants' ability to complete questionnaires. The article discusses issues related to the development of the questionnaires, context-specific challenges before and during implementation of the surveys, and creative strategies to overcome barriers. Lessons learned, and recommendations to increase opportunities for a successful SMS survey, are included.

Conclusions: Understanding the social and economic context of mobile phone use in the target area and careful crafting of SMS questionnaires can produce useful data that may rival information captured through other approaches, such as Knowledge, Attitudes and Practices (KAP) surveys. Despite the challenges experienced, there is room for more consistent and widespread use of SMS for data collection in Latin America.

Keywords: Short message service (SMS); rapid monitoring; social and behavior change communication (SBCC); Zika virus; mobile phones; SMS survey

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Introduction

The most accessible form of mediated communication in world history is now the mobile phone, and it is no surprise that text messaging, also known as short message service (SMS), has become one of the most frequently used forms of mobile communication (1). As the need for rapid, responsive, and less expensive monitoring methods increases, it has become even more necessary to understand the complexities surrounding mobile phone use and how the SMS approach can be leveraged in the context of resource-constrained communities.

In 2016, 63% of the global population were estimated to own a mobile phone, with growth forecasted to continue linearly (2). Today, there are over 5 billion wireless subscribers, and more than 70% of these mobile phone users live in low- and middle-income countries (LMICs) (3). Ownership and use of mobile phones have become increasingly popular: Between 2002 and 2014, mobile phone usage in seven African countries increased to a level that rivaled rates in the USA, with a concomitant decrease in landline telephones. Specifically, in 2014, mobile phone ownership was 89% in the USA and in South Africa, 83% in Ghana, 82% in Kenya, and 73% in Tanzania. In addition, few individuals—11% from Nigeria, 17% from Senegal, and 18% from Kenya, to name a few—reported that they did not own a cell phone (4). In Latin America, the penetration rate for standard mobile phones is very high, including among lower-income groups (5), and unique subscribers in this region have increased, on average, 5% per year (6).

As the global use of mobile phones continues to increase rapidly, advancements also continue in the innovative application of this technology to public health interventions, also known as mobile health (mHealth). Data supporting the frequent use and vast reach of SMS make it well suited for delivering and assessing many aspects of public health programming. Approximately 75% of all mobile phone users use SMS to create and exchange alphanumeric messages in real time (1). While SMS is most commonly used to send messages from person to person via one mobile phone to another, it is also possible to use it to send bulk messages to a large number of recipients simultaneously. Specialized SMS software applications are required to deliver such large-scale text messaging (7).

In the last decade, there has been a surge of interest in using mobile phones to collect high-quality program data in LMICs (8). In particular, the use of SMS has rapidly expanded among programs that deliver targeted health messages and interventions that aim to change health behaviors and improve health outcomes on a large scale in LMIC settings. Such use includes among programs for disease prevention and health promotion, case surveillance and tracking, referrals and improvement of use of health services, and interventions for the management of adherence and compliance with treatment (1,9). Health information is collected from or shared with participants via SMS by sending questions or reminders to their mobile phones (10). Reviews of past SMS interventions have presented considerable advantages for controlling diseases and improving the process of care in LMICs. Studies show also that SMS approaches have been well accepted by both health workers and the target audience (9).

The importance of mobile phone use for risk communication, information sharing, and development of effective crisis response activities has, in recent years, been amplified during natural disasters and humanitarian emergencies. Studies conducted about recent crises found that mobile phones played a role in decreasing the number of people killed or affected by natural disasters (11), and that 71% of refugee households had a mobile phone (12) for information-seeking. Use of mobile technologies has allowed teams to access communities that may be inaccessible due to factors such as location or safety (13). It is now well known that mobile phones can effectively support communication among impacted communities and facilitate rapid dissemination of critical information needed to enable an effective response during emergencies.

Although the use of SMS approaches to support health interventions in LMICs continues to steadily increase, few studies have used this method to collect population-level estimates, and few research studies have discussed important key factors related to data collection via SMS including costs, completion and refusal rates, and demographic representativeness (10). Understanding of how SMS surveys are influenced by these factors could enhance their potential to produce rapid and reliable data about a population's health. Use of SMS during health emergencies could also provide important information about community beliefs, knowledge and behaviors to inform response programs and interventions. This article describes experiences regarding the use of SMS to collect monitoring data about Zika-related knowledge and prevention behaviors, and related lessons and recommendations to increase opportunities for successful use of SMS within the context of Latin American populations.

The Health Communication Capacity Collaborative (HC3), based at the Johns Hopkins Center for Communication Programs (CCP), was a federally funded global initiative from 2012 to 2017 that aimed to increase capacity in the development of sound health communication programs and social and behavior change communication (SBCC) interventions. HC3 supported a Zika program in Honduras, El Salvador, the Dominican Republic, and Guatemala. The program worked with stakeholders to develop strategic documents and operational plans to guide national and subnational SBCC initiatives that addressed Zika. Part of this work included the collection of data from USAID-funded program areas to provide information on general knowledge about Zika prevention and individual Zika prevention behaviors to inform funded program activities.

The HC3 Zika program began in September 2016 in the four focus countries. Program activities included working with governments, implementing partners, and local stakeholders to develop or refine Zika strategic communication plans to support coordinated and harmonized activities in each country. HC3 developed and implemented a SMS survey in the four focus countries to derive estimates for indicators on Zika-related knowledge and prevention behaviors. The survey was conceived as a monitoring activity for specific indicators prioritized by the funder. The objective of the Zika SMS survey was to provide data about Zika-related knowledge and prevention behaviors from individuals in areas with USAID-funded programs and a high Zika case prevalence. Monitoring estimates were expected to provide beneficial information for HC3 and program partners to use in prioritizing and strategizing effective interventions to combat Zika.

This paper describes experiences developing and implementing a SMS survey to collect serial monitoring data on Zika-related themes from high case prevalence areas in the Dominican Republic, El Salvador, Guatemala, and Honduras. The aim of the paper is to provide researchers, monitoring and evaluation staff, and program teams with contextual considerations and guidelines for successfully using SMS methods for data collection.

Methods

The following summarizes the Zika SMS survey design, development, and implementation:

Study methods

SMS was used to conduct a rapid assessment of knowledge of risk and prevention of Zika, and individual prevention behaviors undertaken in the last 30 days to avoid Zika infection.

Study area

The SMS survey targeted individuals living in areas with USAID-funded programs related to Zika prevention and care. The identified survey sites were intersected with case prevalence estimates documented by the World Health Organization (WHO) and country health authorities. Sites with high case prevalence and a USAID-funded program were selected from each of the four participating countries.

Target population

Eligible participants were men and women 15–49 years of age living in the selected sites in Honduras, El Salvador, the Dominican Republic, and Guatemala.

Question development

Questions that addressed the monitoring indicators were identified from the question bank provided by the WHO Resource Pack on "Knowledge, Attitudes and Practice surveys: Zika virus disease and potential complications" (14). Potential survey questions also included tested questions from Knowledge, Attitudes and Practices (KAP) and omnibus questionnaires used by program partners in the study area. Questions were adapted as needed to align with the relevant indicator and meet SMS formatting needs.

Questionnaire

Two quantitative tools were used to collect data: the first 10-item questionnaire focused on knowledge of transmission, risk, and prevention of Zika infection, and the second 8-item questionnaire focused on actions implemented by individuals to protect themselves and their families from Zika infection. Each questionnaire included two screening questions related to residence (department or municipality where the participant had slept the most in the past 30 days) and age, and two demographic questions related to gender and pregnancy status. The final questionnaire was translated to Spanish and then proofread for errors and context by

staff in Baltimore and in each country.

Ethical review

The Johns Hopkins University School of Public Health Institutional Review Board classified this activity as non-research and within the domain of public health practice.

Survey trial phase

Avtek SMS/Asterisk software was used to operationalize the survey. The questionnaire was tested through internal and external trials to assess the level of understanding of the questions, feasibility of completing questionnaires on basic and non-Android phones, and to measure response rates, including rates for incomplete questionnaires.

Sampling

The data collection partner collaborated with local telecommunication agencies in each country to develop a sampling frame of participants, based on mobile phone registration records that included addresses within the survey area.

Data collection

Three waves of data collection were conducted during January to February 2017, April to May 2017, and June to July 2017 to derive estimates for the indicators. In each country, an invitation to participate in a Zika-related survey was sent to a randomly selected burst of mobile phone numbers generated from the country's sampling frame. The message introduced the survey and invited individuals to voluntarily participate. Those who accepted the invitation by sending a text message indicating their willingness to participate received the two screening questions to determine their eligibility. Responses from potential participants that did not meet the geographic or age screening criteria received an automated message thanking them for their interest, the mobile phone number was filtered out of the participant list, and the number was disconnected from the survey. Those with geographic and age requirements that met the eligibility criteria were notified of such and informed they would receive a $5 credit of talk time/message units on their phones at the completion of the questionnaire. Eligible participants were then connected to the questionnaire for completion.

Participants both received and responded to the questions via SMS. Each question was submitted to a country's database as it was completed, and also was aligned with a unique case number assigned to the participating mobile phone number. Additional bursts of mobile phone numbers were added to the pool of potential participants as needed, until the desired sample of at least 1,000 unique case numbers per country with completed questionnaires was achieved.

Completion statistics

The duration of time to achieve the expected sample size ranged from 6 to 16 days for the 10-item knowledge questionnaire, and 5 to 14 days for the 8-item questionnaire. Response rates varied widely by country, and were calculated as the proportion of messaged cell phone numbers that returned a completed questionnaire; for the 10-item questionnaire, this ranged from 37% to 87%, and for the 8-item questionnaire, it ranged from 18% to 82%.

Results

This section describes experiences, challenges, and the actions to mitigate them during the planning, design, and implementation of the Zika-related SMS survey in four Latin American countries. Lessons and considerations to facilitate the use of SMS for data collection and monitoring are included to provide best practices for the successful collection of good-quality data.

Planning the SMS survey

As with any research survey, using SMS methods for data collection requires careful planning and consideration of contextual factors that could influence the decision to use the SMS approach as well as the outcome of the survey. Key issues to assess during the planning phase include market penetration of mobile phones, access to and use of mobile phones, and vendors with expertise in SMS methods.

Market penetration of mobile phones

Ownership and distribution of mobile phones in the study area is central to the decision to conduct an SMS survey. Knowledge of population sub-groups who own a phone and the context within which phones are usually used, could help determine if the SMS survey is likely to reach the target population and yield expected data. From 2010

to 2015, the number of mobile phone subscribers in Latin America and the Caribbean grew 802.5%, compared to fixed connections such as landlines, which only grew 69.8% (15). An exploration of telecommunications in the four focus countries showed that ownership of mobile phones was high: 91% in Honduras (16), 88% in Guatemala (17), 90% in El Salvador (18), and 82% in the Dominican Republic (19). In addition, overall, the data showed little variation in access to mobile phones by geographic location. Country-specific information was also obtained from locally-based program staff. These findings supported the use of SMS as an appropriate method for data collection to support monitoring.

Prior to developing a SMS survey, it is important to understand the scale of mobile phone ownership in the study area. This data is readily available from global telecommunication surveys and databases, including World Bank Data, Pew Research, Statistica, and from national Census and Demographic Health Surveys. Locally-based program staff and telecommunication authorities may also provide important information about phone ownership in specific locations. Some questions that could help inform decisions regarding the appropriateness of using the SMS survey approach include:

(I) What proportion of the population owns a mobile phone?
(II) What proportion of the population owns a cellular phone? A smartphone?
(III) How does ownership of mobile phones vary by geographic factors?

If ownership is not high, distribution by demographic factors could provide important data regarding how phone ownership intersects, and perhaps varies, with characteristics of the target population.

Access to mobile phones

It is essential to confirm that the target population has *access* to mobile phones prior to making decisions about using SMS as a survey method. While overall mobile phone ownership rates may be high in a country, knowledge of what segments and demographic characteristics of the population routinely use mobile phones could provide additional information that may be important for meeting study objectives. Studies have shown that older adults have many barriers when using new technology like mobile phones; their lack of experience and knowledge about the use of mobile phones creates an overwhelming and difficult learning process (20). A study of several Latin American countries indicated that regardless of whether the respondents owned their own phone, the majority had used a mobile phone in the past 3 months (21), demonstrating that mobile phone access does not necessarily imply ownership. An anthropological study in Guatemala showed that in rural areas, the male head of household managed access to the family's mobile phone (22) implying possible gender-based differences in ownership and access to the phone and indirectly to any surveys using SMS.

Knowledge of characteristics of mobile phone users in a particular context provides information about whether the target population could be reached via SMS methods. In many LMICs, some individuals do not own a mobile phone, but have access to a shared "community phone" owned by another who offers pay-to-use services. While this practice increases the proportion of the population with access to a phone, access is not continual, but intermittent and determined by need rather than by other social factors. Filtering and tracking participant responses by gender and age would be an important strategy to minimize response bias and to ensure that desired age categories are well represented within the final sample.

Consequently, access to mobile phones should not be an independent factor in determining the appropriateness of SMS survey methods for data collection. Literacy is another essential factor to consider. In communities where literacy rates are low, the SMS survey method would not be feasible, as participants would be unable to read the text messages being sent to them.

Questions to help further define mobile phone users in the study area include:

(I) What proportion of households have a mobile phone?
(II) How does the use of mobile phones vary by demographic factors, such as gender, location, income level, and literacy rates?
(III) What is the difference between ownership of and access to mobile phones?
(IV) How are mobile phones used in the study area? (i.e., for texting, photos, calls, etc.).

Patterns of mobile phone use

Patterns of mobile phone use may vary in different geographic areas. For instance, in urban areas, individuals spend increased amounts of time on mobile phones to access social media platforms and the internet, while in rural areas, mobile phones are used mainly for contacting others. A study in Mexico that examined mobile penetration

by socioeconomic status found increased use of mobile phones among the two lowest socio-economic groups. In addition, mobile phone users classified into lower-income categories indicated that they purchased their phone for purposeful reasons, such as the need to be located and making job-related or personal calls, rather than for entertainment (21). Intermittent use of phones in rural areas may affect awareness and receipt of survey notices, and therefore impact survey response rates. In some areas, where electricity is intermittent, willingness to participate in SMS surveys also may be influenced by competing functions of the mobile phone for the power supply: Individuals may elect to conserve the device's supply of power rather than use it to complete an SMS survey. While portable personal solar charges and power banks may help to ensure mobile devices have a continual source of power, this technology may be available only to select segments of the population and may be limited in rural areas.

Use of mobile phones also may be hampered by variations in the presence or strength of network signals in certain geographic areas. In many underserved and rural communities with few telephone signal towers or geographical reception barriers, and for those using older-generation mobile phones with slower broadband capabilities, users usually have to move to specific vantage points that are known to have a stronger network signal before they can use their mobile phones. These issues may potentially influence who is able to receive and participate in the SMS survey. Discussions with program staff about a landscaping visit to the predominantly urban areas included in the Zika survey provided insights about the use of mobile phones in the target areas. Information about patterns of mobile phone use in the target areas was confirmed by the contractor, who had working relationships with the telecommunication companies in each country.

Understanding the patterns of mobile phone use among the target population could help maximize access to the SMS survey. Most often, a visit to the study area or discussions with community-based program representatives and local residents may provide information about who uses mobile phones, when they are usually used, and for what purposes.

Questions that help characterize the use of mobile phones in the study area include:

(I) What is the network coverage for telecommunications in the study area?
(II) Are there variations in the network signal strength across the study area?
(III) How does network coverage influence mobile phone use?
(IV) How easy is it to make a call or maintain a call from a mobile phone in the study area?

Types of phones in use

The types of mobile phones commonly used in the study area has direct bearing on the ease with which a SMS survey can be completed. Cellular phone features of relevance to SMS survey design differ for basic, feature, and smartphones. For instance, battery life, network speed, display screen size, touchscreen ability, and virtual keyboards versus text and number pads have implications for the design of survey questions and response options. In many parts of the world where SMS may provide quick access to hard-to-reach communities, basic mobile and feature phones may be the predominant types of phones in use. Many of these phone types typically have smaller display screens, non-interactive screens, and use text and number pad features, all of which affect the ease of completing an SMS survey.

In Latin America, the basic feature phone is very common; this type of phone is generally the cheapest mobile phone available and has only basic functions, such as voice calls or SMS (23). Excluding telephone calls, text messaging is the only mobile phone service that is being rapidly adopted across Latin America. In some countries with more developed telecommunication markets, such as Jamaica and Argentina, text messaging is also used by the majority of low-income mobile phone users (21).

Questions that help characterize the type of phone in the study area include:

(I) What type of phone is most commonly used in the target areas?
(II) How will the study tool function on the most common type of phone available in the target area?
(III) What are common issues encountered by mobile phone users that may need to be considered during study design, such as difficulty with alphanumeric keyboards?

Selecting the telecommunications contractor

The choice of telecommunications partner to assist with developing and fielding the SMS survey is important to the derivation of high-quality data. A partner with experience in developing and administering SMS-based surveys or opinion polls, and one that has collaborated on research or monitoring and evaluation studies, is ideal but not always

easy to identify in some countries.

Some companies with SMS-focused capacities have captured the market for SMS-related data in different parts of the world. In some cases, companies that routinely conduct activities using SMS and other telecommunication data have negotiated contracts with telecommunication companies that include options for no-cost responses to SMS surveys. While this was not true for the four focus countries at the time of the survey, locating a contractor with established relationships with telecommunication companies is ideal and will be beneficial to data collection using SMS methods. At the time of the survey, in the four focus countries, a web-based search of telecommunication companies with capabilities of conducting SMS surveys in Latin America yielded only one agency that could perform the scope of work in all the target areas and in all four countries.

Using a data collection contractor that has existing relationships with telecommunication companies may influence negotiations for a lower-cost survey, and even one that may be free to participants. While the contractor used for the survey had substantial experience conducting SMS surveys, they had no long-term contract with telecommunication companies to support all their SMS-related data collection and negotiated with these companies as the need arose. Consequently, participants were expected to use their own phone units to participate in the survey and received a credit top-up of units when they submitted a completed survey. In the target countries with few customer options for special monthly service packages that include unlimited text messaging, the survey participants incurred a cost for every text character submitted in response to the SMS survey (including for incompletes and abandoned questionnaires). This caused a fair number of participants to run out of phone units before they completed the questionnaire, forcing them to stop their participation prematurely. Using one's phone units to pay for voluntary participation in an SMS survey differs from SMS survey administration in other geographical areas, including some sub-Saharan countries, where mobile phone users may have unlimited texting packages, or contractors may have negotiated arrangements with telecommunication companies for the cost of SMS surveys to either be transferred to the contractor or be covered in a single negotiated price, so that participation in the survey is free to participants.

Options for the use of SMS for data collection continue to expand: More companies with electronic data collection and warehousing applications are now offering one-stop shop SMS data collection as part of their electronic data collection, warehousing, and visualization services.

Questions to guide the selection of an agency to field the SMS survey in the identified areas include:

(I) Does this vendor have experience implementing the method of interest in the target areas?
(II) What type of relationship does the vendor have with the local telecommunication companies?
(III) How familiar is the vendor with the local context?
(IV) What proportion of mobile subscriptions in the target area are pre-paid?
(V) What are the possibilities for a no- or low-cost SMS survey for participants?

Developing the initial questionnaire

The nature of SMS applications and specific features of messaging platforms have direct implications for the questionnaire design. Decisions regarding question structure (structured versus unstructured), complexity and length of sentences, number of questions and response options, and use of logic, images, and internet URL links, are influenced by specific requirements for text messaging, and to some extent, the type of phones predominantly used by the target population. These factors should be considered when developing a questionnaire for an SMS-based survey.

Tool development considerations

Length of the questionnaire

Generally, SMS surveys are appropriate for soliciting information on broad-based topics such as opinions and awareness, or narrow and focused themes related to specific knowledge or actions. The objectives of the survey can provide helpful guidance for defining and maintaining the focus of the enquiry and for developing the questionnaire. For this study, the SMS method was used to field a questionnaire about a defined health area, Zika, and to derive estimates specifically for knowledge and prevention behaviors. In addition, within the domain of knowledge and behaviors, the questionnaire focused more on knowledge of sexual risk, transmission, and behaviors.

Developing the survey instrument to support a program monitoring activity is usually a clear-cut process as potential questions are prioritized for selection based on how well they align with program indicators: questions that provide data on numerators and denominators are ranked higher.

As questionnaires delivered via SMS methods are typically short in length, identification of relevant questions is best guided by a prioritization scheme that distinguishes questions that fulfill a "need to know" from "want or nice to know" information. SMS surveys typically ask 8 to 10 questions, although in some cases, slightly lengthier questionnaires have been used successfully.

Sentence structure and question length

Short, simple, and easy-to-understand questions are best suited for an SMS-based survey tool, as there is little room for introductory text. More importantly, participants do not have the opportunity to ask clarifying questions if a question is unclear to them. Of note, in the context of a health pandemic and associated competing telephony priorities, higher participant response rates to the survey may be achieved with shorter questionnaires that are quick and easy to complete. SMS application features also have implications for the length of questions included in the survey instrument. Messaging software allows for a total of 160 characters (including the use of the space bar), for introductory text, numbering, the question, and response options. Consequently, it is challenging to include questions that are lengthy, have more than 4 to 5 response options, have multiple-choice short-answer phrases for responses, or that are semi-structured and require qualitative responses. Decisions will have to be made regarding what questions are essential to include in the survey, and how they should be phrased.

Number of response options

Consideration of phone screen size is important during the development of survey questions, as this relates to how much the participant will be able to read without scrolling. The more response options there are, the more difficult it is for participants to visualize questions in their entirety, and the more confusing it is for those using phones with small phone screens to scroll through and visualize all parts of the question. In such instances, and when completing the questionnaire becomes tedious, participants may be prone to select the first response option they see, rather than scrolling through to see all available responses.

Language and translations

There is a need to be cautious of not using language that is too complex for the communities being targeted via mobile phone. It is important to use language and terms that are applicable to the local context, especially in lower-income areas with low literacy rates. When translating certain specific technical terms, it was important to get feedback from local partners and in-country program staff who knew what would be more commonly understood or applicable to the situation we were interested in.

Choose filter and demographic questions wisely. For instance, it is best to collect interval-level data for age and customize several age categories during analysis, versus collecting ordinal defined data for age. Use of appropriate measures for demographic variables will allow audience segmentation and may potentially produce much insight about groups in the target population.

Testing the SMS survey

The questionnaire should be finalized based on the results of a pre-test implemented under conditions similar to that of the local context and target population. Testing the survey increases the likelihood of successfully administering a culturally appropriate survey that is clear, easily understood, and feasible to implement locally. This is key for administering a survey that has limited space for written instructions, and also does not provide opportunities for participants to ask questions about issues that may be unclear.

We conducted several tests of the Zika questionnaires. First, we conducted an internal test of the survey among 400 employees working for the contractor. The trial yielded a 1% (4 participants) completion rate, with no responses provided for multiple-choice questions. Employee participants reported that the length of the survey, the complexity of the questions, and use of non-Android phones to respond to the survey influenced completion rates. The questionnaire was modified to simply complex questions, and a second test among 4750 cell phone numbers in Guatemala was done. This external trial yielded 30 completed questionnaires and a response rate of <1%. We identified several factors as potentially contributing to the low response rates:

- Length: a 12-item questionnaire (implemented in the trial runs) may be too long for the target population.
- Response options: almost all the questions had 5 to 8 response options, including standard options for "don't know," "refuse to answer," and "other" with write-in details. Feedback from participants who did not complete the questionnaire during the pretesting exercises revealed that the majority perceived scrolling through multiple response options to be confusing and cumbersome. When there were many response options, some participants could not always remember the

number on the keyboard that represented their response.

- ❖ Phone type and screen size: reading the survey questions was cumbersome, as survey questions often overflowed the small screens of non-Android phones commonly used in the target area. Multiple and lengthy response options also could not be easily viewed and selected, as they were not in the visible space and required scrolling back and forth.
- ❖ Cost: participants incurred higher texting costs when responding to the multiple-choice response questions, as did the vendor.

In response to this feedback, the number of questions in the Zika survey tool was decreased to no more than 10 questions. To further simplify the instrument, the questionnaire was divided into two shorter instruments based on the indicators: a 10-item Knowledge Survey that focused on knowledge of risk, transmission, and prevention strategies, and an 8-item Self-Actions survey that focused on prevention behaviors. An additional strategy was to convert each response option for the multiple-choice questions into separate categorical questions with dichotomous response options such as "True/False" and "Yes/No" that were easier to respond to. Dividing the initial instrument into two different questionnaires fielded two weeks apart affected the ability to correlate participant knowledge with participant behaviors from one cross-sectional sample. However, we were able to use GIS mapping to show that the sample for both surveys overlapped the same geographic areas and participants had similar demographic characteristics.

These revisions to the questionnaire appeared to facilitate easier completion and improved the completion rates for the survey.

Preparing communities

Pre-survey preparation among members of the target population may be necessary in order to increase acceptance of the survey and improve participation and completion rates. Factors to consider when preparing communities for the launch of an SMS survey are described below:

Perceived legitimacy of the survey

When fielding an SMS survey, mobile phone users in target communities may be wary of the legitimacy of the survey, especially when top-up credit is promised as an appreciative token for completing the survey. During the initial phase of the Zika SMS survey, the number of uncompleted surveys were high and the contractor encountered difficulty achieving completion rates in specific geographic localities. Discussions with locally-based staff and community leaders from some of the affected areas revealed that individuals may have had doubts regarding the legitimacy of the SMS survey. At the time of the survey, in El Salvador and Guatemala, violent gangs known as "maras" were reportedly using mobile phones to extort money from individuals. Consequently, in some areas, people who received the survey believed it to be a hoax and were hesitant to participate due to fear of future extortion demands. This was resolved in subsequent waves of the survey by preparing the communities through informative public service announcements.

Anonymous and confidential participation

As with any research or data collection activity, participants may be concerned about issues related to anonymity and confidentiality. This is especially true when the survey includes questions of a personal and sensitive nature, or questions that may be considered taboo in the local context, such as those related to family planning or reproductive and sexual health that were included in the Zika SMS survey. These concerns should also be addressed generally within the context of any local security and cultural issues when providing information about the future launch of an SMS survey.

Fielding the survey

Participation in data collection activities is often associated with costs to the participant. Depending on the topic, these costs may be physical, psychosocial, or emotional, or they may be related to finances, time, and resources. Costs associated with participating in the SMS survey may potentially impact completion rates and are described below.

Financial

As introduced earlier, in some countries, participants may incur costs when they participate in SMS-based surveys. The cost of text messaging can vary depending on the type of mobile phone subscriptions that are most common to the target area. When initially fielding the Zika SMS survey, a credit top-up of phone units was offered to participants as a token of appreciation for their time completing the survey. The credit amount was determined in consideration of the estimated cost in phone units for participating in the survey.

However, the completion rates were very low. Analysis by the telecommunications company showed that participants were accepting the survey, but running out of texting credit on their phone plans prior to completing it.

Knowledge of phone subscriptions in the target area may provide useful information to support the completion of SMS surveys. As of early 2017, pre-paid mobile phone subscriptions were high in Latin America: 84% in El Salvador (24), 94% in Guatemala (24), 92% in Honduras (24), and 77% in the Dominican Republic (19). This information showed that the majority of subscriptions were based on a pay-to-use system; therefore, an individual's decision to participate and ability to complete the questionnaire may be influenced by their balance of phone credits at the time they receive the survey notice.

As a strategy to improve completion rates, the Zika SMS survey was modified to provide participants with a partial credit top-up at the beginning of the survey, to support their ability to complete it. The remaining top-up was credited upon receipt of the completed survey. The risk of this approach is that some participants may accept and use the partial credit and not complete the survey. Knowledge of the type of mobile phone subscriptions within the specific target communities can provide understanding regarding how to counteract any participant costs that could negatively affect participation.

Time

The amount of time it takes to complete the survey can impact whether or not a respondent completes participation. As described in the section regarding questionnaire development, it is important to keep the questionnaire short and the questions succinct and concise so that participants do not feel burdened.

Power usage

While countries across Latin America have high mobile penetration rates, the use of smartphones and phones with internet remains low, demonstrating an apparent digital divide in the region. This digital divide represents gaps in access to modern information and communication technology across different demographic and regional groups (25). These gaps highlight the underlying structural inequalities often seen in LMICs, and may also serve as barriers to participation in SMS-based surveys. For some countries, one such barrier may be the electricity divide, which is closely related to the digital divide. Without addressing issues related to continuous availability of power, it may be difficult to bridge gaps in access to communication technology (26). Responding to an SMS survey can result in power usage costs for participants if they live in areas where there is no or intermittent electricity. The longer it takes a participant to complete the SMS survey, the higher the potential power usage cost. Where there are limited power resources, participants may anticipate depleting their battery power during the SMS survey and choose to not respond.

Discussion

SMS was used to collect data for monitoring indicators related to Zika in Honduras, El Salvador, the Dominican Republic, and Guatemala. Important lessons learned from this experience about designing and implementing SMS-based surveys in Latin America are summarized as follows:

(I) Understanding the local context of mobile phone ownership in the target area and among sub-groups of the target population may provide important information about how well the SMS approach may reach the expected population.

(II) Not all mobile phone types are best suited for SMS surveys. While smartphones are ideal, in many LMICs, the most commonly used phone type will have basic features with a small digital screen.

(III) While SMS-based surveys are typically simple and easy to understand, the development of well-written survey questions can be a long and sometimes challenging process, even for simple questionnaires. Use of a prioritization or ranking scheme to select questions helps keep the questionnaire focused on the survey objectives.

(IV) Shorter questionnaires and short, simply-phrased questions with dichotomous responses generally work best for SMS-based data collection.

(V) Contractors with experience conducting research- or monitoring-based SMS data collection may be difficult to find locally; however, SMS approaches are becoming increasingly available through electronic data collection platforms.

(VI) Negotiating participant costs with the data collection contractor is highly recommended when conducting SMS-based surveys in LMICs.

(VII) Investing time in pretesting the initial questionnaire should not be undervalued, even for simple

questionnaires; testing the tool may reveal overlooked issues that directly impact the successful completion of the survey. The pretest is essential to the development of a tool that is not only accepted locally, but is also easy for participants to complete.

(VIII) For some communities, it might be worthwhile to give advance notice of an impending SMS survey. Such notices may dispel rumors about the survey and could increase participation in areas where mobile phones are more commonly used purposefully rather than socially. Strategies should be carefully developed so as not to bias the recruitment and sample.

(IX) Providing financial support upfront to support participant completion of SMS surveys is a need in many LMICs, especially in areas where the majority of low-income mobile phone users have pre-paid subscriptions. This financial credit is especially helpful in areas where text messaging services are not free, and participation in SMS surveys results in a personal financial cost to participants.

Conclusions

The SMS method was used in four Latin American countries to collect monitoring data about knowledge of risks, transmission, and prevention of Zika, and use of specific behaviors to prevent Zika. Three waves of the survey were successfully implemented within a seven-month period.

Through the use of the SMS method for data collection, the HC3 Zika program collected serial monitoring data and showed that this method could work well for rapid monitoring when there is careful consideration of factors such as SMS questionnaire development, contractor experience, and the local community context. This SMS survey demonstrated the successful use of mobile telephony for quick, focused program monitoring.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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References

1. Hall AK, Cole-Lewis H, Berhardt J. Mobile Text Messaging for Health: A Systematic Review of Reviews. Annual Review of Public Health 2015;36:393-415.
2. Number of mobile phone users worldwide 2013-2019. Statista. Available online: https://www.statista.com/statistics/274774/forecast-of-mobile-phone-users-worldwide/. Published August 2015. Accessed March 15, 2018.
3. World Health Organization. mHealth: New horizons for health through mobile technologies. Observatory 2011;3:66-71.
4. Guyon A, Bock A, Buback L, et al. Mobile-Based Nutrition and Child Health Monitoring to Inform Program Development: An Experience From Liberia. Glob Health Sci Pract 2016;4:661-70.
5. Lugo MT, Schurmann S. Turning on mobile learning in Latin America: Illustrative initiatives and policy implications. UNESCO Working Paper Series on Mobile Learning. 2012.
6. Sharma A, Barbara AL. Connected Society Digital inclusion in Latin America and the Caribbean. 2016:66. Available online: https://www.gsmaintelligence.com/research/?file=895f6c0a1efa7a25f5d6b4ff874e92f1&download
7. Schilling L, Bennett G, Bull S, et al. Text Messaging in Healthcare Research Toolkit. 2013:42.
8. Dabalen A, Etang A, Hoogeveen J, et al. Mobile Phone Panel Surveys in Developing Countries: A Practical Guide for Microdata Collection. 2016.
9. Déglise C, Suzanne Suggs L, Odermatt P. SMS for disease control in developing countries: A systematic review of mobile health applications. J Telemed Telecare 2012;18:273-81.
10. Gibson DG, Pereira A, Farrenkopf BA, et al. Mobile

Phone Surveys for Collecting Population-Level Estimates in Low- and Middle-Income Countries: A Literature Review. J Med Internet Res 2017;19:e139.
11. IFRC. World Disasters Report: Focus on Technology and the Future of Humanitarian Action; 2013.
12. GSMA. Disaster Response: GSMA Humanitarian Connectivity Charter: Annual Report 2016. 2017.
13. Berman A, Figueroa ME, Storey JD. Use of SMS-Based Surveys in the Rapid Response to the Ebola Outbreak in Liberia: Opening Community Dialogue. J Health Commun 2017;22:15-23.
14. World Health Organization. Knowledge, Attitudes and Practice surveys: Zika virus disease and potential complications. WHO Press World Heal Organ. 2016.
15. Delisle M. Mobile Users and App Usage Soar in Latin America. Digital Turbine. Available online: https://www.digitalturbine.com/blog/mobile-users-and-app-usage-soar-in-latin-america/. Published November 3, 2016. Accessed March 18, 2018.
16. Mobile telephony penetration rate in Honduras 2017. Statista. Available online: https://www.statista.com/statistics/802583/honduras-mobile-telephony-penetration-rate/. Accessed March 15, 2018.
17. Lancaster H. Guatemala - Telecoms, Mobile and Broadband - Statistics and Analyses. BuddeComm. Available online: https://www.budde.com.au/Research/Guatemala-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses. Published February 28, 2018. Accessed March 14, 2018.
18. Lancaster H. El Salvador - Telecoms, Mobile and Broadband - Statistics and Analyses. BuddeeComm. Available online: https://www.budde.com.au/Research/El-Salvador-Telecoms-Mobile-Broadband-and-Digital-Media-Statistics-and-Analyses. Published July 19, 2017. Accessed March 14, 2018.
19. We Are Social Singapore. Digital in 2017: The Caribbean. Available online: https://www.slideshare.net/wearesocialsg/digital-in-2017-the-caribbean. Published January 26, 2017. Accessed March 12, 2018.
20. Fletcher J, Jensen R. Mobile health: Barriers to Mobile Phone Use in the Aging Population. Online J Nurs Inform 2015;19(3).
21. Mariscal J, Galperin H. Poverty and Mobile Telephony in Latin America and the Caribbean Poverty and Mobile Telephony in Latin America and the Caribbean Hernán Galperin. 2007.
22. Olivet Lopez AL. Mobile phones vs the food basket in Guatemala. Institute of Development Studies. Available online: https://www.ids.ac.uk/opinion/mobile-phones-vs-the-food-basket-in-guatemala. Accessed March 15, 2018.
23. Hurtado P. Del Frijolito al BlackBerry. elPeriódico de Guatemala. Available online: http://www.elperiodico.com.gt/ es/20110410/domingo/193903. Published April 10, 2011. Accessed March 18, 2018.
24. We are Social Singapore. Digital in 2017: Central America. Available online: https://www.slideshare.net/wearesocialsg/digital-in-2017-central-america. Published January 26, 2017. Accessed March 12, 2018.
25. Álvarez M. Latin America's digital divide. LatinAmericanScience.org. Available online: http://latinamericanscience.org/2014/05/latin-americas-digital-divide/. Published September 29, 2014. Accessed March 19, 2018.
26. Trucano M. How many schools are connected to the Internet? Edutech. Available online: https://blogs.worldbank.org/edutech/how-many-schools-are-connected-internet. Published June 12, 2015. Accessed March 19, 2018.

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