Chapter 8. Process evaluation of an mhealth intervention for people with diabetes in low income countries – the implementation of the TEXT4DSM study

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Abstract

Introduction
Evidence about mobile health approaches to manage diabetes shows modest effects on outcomes, but little is known about implementation variability. This is a process evaluation of an mhealth intervention to improve diabetes self-management through Short Messaging Services in three diabetes care programs in DRC, Cambodia and the Philippines.

Methods
The intervention involved Diabetes Self-Management Support via text messages. The content and process of the intervention is based upon the core principles of diabetes self-management and behaviour theory. In each country, messages were sent by project managers to 240 participants in each country, who were randomly assigned to the intervention group. Contracts were negotiated with national phone providers and open access software was used to send the messages. Participants received a mobile phone and SIM card. We analysed data about the implementation process over a one year period.

Results
The mean monthly number of messages delivered to recipients' phones was 67.7% of the planned number in DRC, 92.3% in Cambodia and 83.9% in the Philippines. A telephone check revealed problems with one third of the phones, including breakage, loss and cancelled subscriptions. The number of people reached at least once was 177 (70.0%) in DRC, 147 (60.7%) in Cambodia, 5 in the Philippines (2.0%). Those reached each time was 144 in DRC (56.9%), 28 (9.9%) in Cambodia, 0 in the Philippines. People used their phone more frequently than before the intervention.

Discussion
Implementation of the intervention meets constraints at every step in the process. Barriers relate to the technology, the context and the participants.
Introduction

Improving the self-management capacities of people with diabetes has proven useful, contributing to better health outcomes and the feeling of being empowered [1–3]. Well-elaborated guidelines on how to do so exist [4], but there is only scarce evidence relating to their implementation in Low Income Countries (LIC) [5,6].

The use of mobile health approaches to manage diabetes mobile communication technology has been welcomed as a promising tool to further support care and self-management for people with chronic conditions like diabetes (generally referred to as mhealth or mdisease) [7]. However, evidence to support this view is inconclusive. Recent reviews have analysed the effectiveness of mhealth interventions on the adoption of healthy behaviours and improved disease management [8], the effect of direct mhealth interventions on diabetes control [9] and the effect of mhealth interventions in Sub Saharan Africa[10].

Most of the implemented mhealth interventions include Short Messaging Service (SMS), but very few studies of sufficient quality have taken place in LIC. Their results pertaining to effectiveness are not consistent: little effect on behaviour and physical parameters, although some studies showed a slight improvement in diabetes control and blood pressure [11]. Despite the call for more process evaluation to better understand why and how mhealth interventions work [12,13], such publications are scarce. The process indicators in the published reviews related mainly to experiences with the intervention (e.g. ease of use, satisfaction, running costs) [7]. A factor not well explored is the variation in implementation of the planned intervention and how well such interventions are implemented into the busy practice of real life [14,15].

Notwithstanding the apparent feasibility of SMS intervention on a large scale, as suggested for instance by the WHO’s ‘Be he@thy, be mobile’ initiative [16], there is little knowledge about the reach of these interventions and about the barriers to implementation, especially in LIC. How well are these interventions implemented in practice? What are the potential barriers that program managers need to take into account with respect to the field of software adaptation, mobile phone markets and the way people use their phones?

This paper addresses that gap by providing a process evaluation of an mhealth intervention in diabetes care and self-management programs implemented in three different countries: Democratic Republic Congo (DRC), Cambodia and the Philippines. The intervention aims to improve education and behaviour change motivation through the sending of short text messages (SMS) to participants’ mobile phones several times a week. The evaluation identifies barriers in the reach of a seemingly simple intervention, from the planning phase to the final step in the process, people remembering the SMS they received. Our analysis aims to help practitioners to better understand and plan the operationalization of mhealth interventions. Our main research question was: to which degree was the originally planned mhealth intervention implemented and what was the intervention coverage among targeted diabetes patients? We also try to answer the question what factors enhanced or hampered the implementation?

Methods

We analysed data about the process of implementing a Diabetes Self-Management Support (DSMS) intervention by SMS over a one year period for people with diabetes in three existing diabetes care programs: ‘Kin-réseau’ in the DRC, ‘MoPoTsyo’ in Cambodia, and ‘FiLDCare’ in the Philippines. Details about these programs and their context were described elsewhere [17]. This evaluation was part of the TEXT4DSM study, which aimed to evaluate the effectiveness of a mobile phone Diabetes Self-Management Support (DSMS) intervention on top of an existing
Diabetes Self-Management Education (DSME) strategy. The DSMS intervention involved the sending of SMSs to mobile phones. The ongoing DSME was provided by 'educators' (a nurse in DRC, a peer educator in Cambodia, a Community Health Worker or Education nurse in the Philippines). The content of the SMS related to healthy behaviours and disease management [18]. The rationale underling the intervention was based upon the theory of planned behaviour [19]. The common protocol and related documents included a guideline about the content of messages and about the principles of the process, which included the sending of messages several times a week. More details can be found in the study protocol [20].

Procedures

Project managers and their assistants were hired in each country. In each country, those hired were university graduates who were trained in diabetes self-management education, development of messages and the use of the project software (Frontline). They were responsible for the development and sending of messages, and for contact with the participants and other project partners, such as educators and telephone providers.

All participants were given a mobile phone and a valid SIM card (with an initial maximum 1 USD credit). Receiving messages on the mobile phone was free of charge. Contracts were negotiated with a national phone provider for buying new phones for all participants and for sending messages. The open access software Frontline (Occam Technologies, the makers of Frontline (Nairobi and Washington, D.C) was used to automatically send SMS to a group of patients, through a desktop computer, connected with a GSM Modem and a local SIM card [21].

The protocol for messages was developed separately for each country. The country protocols specified that messages were to be sent five times per week in DRC, six times per week in Cambodia and twice per week in the Philippines. These differences were a result of the decisions by the country team, influenced by contractual arrangements and differences in the cost of sending SMS. The cost were covered by the research project. In each country, a team comprised of the project manager, assistant programme manager, an educator and a general doctor with additional diabetes training was set up to develop the messages in conformity with the guidelines in the protocol (covering all dimension of the diabetes self-management curriculum on a rotation basis, with the possibility to focus on those dimensions most relevant in the setting, addressing context-specific barriers – taking into account basic principles of behaviour change theories). The team members met on a regular basis to develop new messages.

The project manager created a group within the Frontline software with some basic personal characteristics such as name and gender. Messages were personalized by adding the individual's name through an automated function of the Frontline software, if the length of message (max 160 characters) would allow so. The project manager entered the messages into the computer and programmed the timing of delivery. If the programme failed to deliver the message to a recipient number (for instance because the line was disconnected or due to a network failure), it retried several times until an ultimate failure delivery notice was received.

Because of the geographical distribution of the care programmes in the Philippines, telephone contracts were negotiated locally and there was no central server system. The free-internet-based application 'Chikka' was used, and – in the event of failure – messages were sent manually from the project mobile phone of the telemedicine assistant [22]. This was more time-consuming than in the other two countries, where the procedure took on average half a day per week.

Participants

The number of participants enrolled in the TEXT4DSM study was 505 for DR Congo, 484 in Cambodia and 481 in the Philippines. An overview of the main characteristics is given in table 1.
More details related to their treatment and self-management behaviour can be found elsewhere [17]. After the informed consent procedure, patients were randomly allocated to either intervention or control group, in conformity with the study protocol. The number of people assigned randomly to the intervention were 253 in DR Congo, 242 in Cambodia and 241 in the Philippines. For the process evaluation, we used data from the participants in the intervention group only.

**Table 1. Participant characteristics at enrolment**

<table>
<thead>
<tr>
<th>Participants enrollment characteristics</th>
<th>DR Congo</th>
<th>Cambodia</th>
<th>Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex male/female</td>
<td>0.48</td>
<td>0.40</td>
<td>0.59</td>
</tr>
<tr>
<td>Age, med (IQR)</td>
<td>62 (55-70)</td>
<td>55 (49-62)</td>
<td>60 (55-65)</td>
</tr>
<tr>
<td>Education level:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>illiterate</td>
<td>14%</td>
<td>27%</td>
<td>0%</td>
</tr>
<tr>
<td>primary level</td>
<td>32%</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>secondary level</td>
<td>37%</td>
<td>40%</td>
<td>31%</td>
</tr>
<tr>
<td>university</td>
<td>11%</td>
<td>2%</td>
<td>58%</td>
</tr>
<tr>
<td>missing</td>
<td>6%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Having a mobile phone before intervention</td>
<td>57%</td>
<td>94%</td>
<td>67%</td>
</tr>
<tr>
<td>start HbA1C median (IQR) (mmol/mol)</td>
<td>69.4 (54.1-92.4)</td>
<td>54.1 (46.3-68.3)</td>
<td>57.4 (47.5-81.4)</td>
</tr>
<tr>
<td>Duration of known diabetes, med (IQR)</td>
<td>7 (4-11)</td>
<td>4 (2-7)</td>
<td>6 (3-12)</td>
</tr>
</tbody>
</table>

**Evaluation framework**

Our evaluation framework is based upon the implementation fidelity framework, which allows for an understanding of how well an intervention is implemented, and the coverage framework, which measures the (hypothetical) decline in coverage of health care interventions at each step [23,24]. Our model describes the process of the implementation of the intervention (from the planned protocol to the successful delivery of the message to the phone) and the degree to which the participants recall having received the intervention.

The steps in the implementation process are depicted in figure 1, the research questions, data sources and measures for each step are listed in table 2.

We diversified the sources of information and the approached to data collection, using technical reports created by the messaging software and the answers of patients and project managers gathered through questionnaires and in-depth interviews.

Data about the SMS being sent and delivered were automatically recorded by the Frontline software. We used the data of project months 1-12 of each country for analysis (April 2013-March 2014 for DRC, October 2012-September 2013 for Cambodia, June 2013-May 2014 for the Philippines). For the Philippines, we used a list of all SMSs sent, which was provided by the programme manager.
Data about the participants were collected in 2012-2014, as part of the TEXT4DSM study during a face-to-face interview using a predefined questionnaire (question 1-8, see web annex or http://www.biomedcentral.com/1471-2458/13/423). They are described in table 2. People that remembered receiving at least one SMS in the last month were counted as 'remembered at least once', people that remembered receiving at least half of the SMS were counted as 'remembered half of the times' (on a monthly basis, this equals at least ten messages in DRC and Cambodia, at least three in the Philippines), people that remembered receiving almost all (on a monthly basis at least 20 messages in DRC and Cambodia, 7 in the Philippines) were classified as 'remembered all of the times'. These cut-off points were chosen to mark a decline in the process, starting from the assumption that this would be linear.

We used an "intention-to-treat (ITT)" approach, using the number of patients, which were included at the start of the study as the denominator, people who were lost to follow-up are reported as missing. The data were collected just before the start of the intervention and one year after the start of the intervention. Additional efforts were made to trace participants who did not come for data collection, with the aim to retrieve them for the study or to get information about the reasons of loss to follow-up. Those reasons were recorded in a database. More details about the data collection are described elsewhere [20].

We also described the actions of project managers to address operational problems and the number of changed telephone numbers. Details were retrieved from study documents and semi-structured interviews with the project managers via Skype, by the first author. The interview reports were validated by the interviewees and triangulated with the data collected via other sources.

An overview of the direct project expenditures related to the intervention is given below, based upon the financial project reports of each country. Direct costs include : development of the intervention, provision of mobile phones for the participants, sending messages during 12 months to participants and staff cost (0.75 fte project management per country).
Figure 1. Process framework to describe the process at the side of the intervention (left) and of the participants’ side (right)
Table 2. Research questions, data sources and measures for process evaluation of mHealth intervention (nr = number, Q=question)

<table>
<thead>
<tr>
<th>Research question</th>
<th>Data sources</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation of the DSMS intervention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many SMSs were planned to be sent according to the protocol?</td>
<td>Study protocol, project documents</td>
<td>planned nr SMSs/week times 52 divided by 12</td>
</tr>
<tr>
<td>How many SMSs were sent?</td>
<td>Frontline report project month 1-12 (DRC, Cam), project manager report (Phil)</td>
<td>12-month mean of nr of SMS sent in a month divided by participants</td>
</tr>
<tr>
<td>How many SMS were recorded to have successfully delivered to the phone?</td>
<td>Frontline report project month 1-12 (DRC, Cam)</td>
<td>12-month mean of nr of SMS arrived in month divided by participants</td>
</tr>
<tr>
<td>Which interventions were done to address operational problems?</td>
<td>Interviews managers, documents</td>
<td>Qualitative description</td>
</tr>
<tr>
<td>How many telephone numbers were changed?</td>
<td>Frontline report project month 1-12</td>
<td>total nr of different phone numbers used</td>
</tr>
<tr>
<td><strong>Process at participants: ability to reach the patient with the DSMS intervention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many patients still have a phone after 12 months?</td>
<td>Questionnaire –based patient interview (Q1)</td>
<td>Patients responding still to have a mobile phone</td>
</tr>
<tr>
<td>How many patients remember having received SMSs?</td>
<td>Questionnaire –based patient interview (Q8)</td>
<td>Nr of patients ‘remembered at least once’ (having received at least 1 DSMS in the last month)</td>
</tr>
</tbody>
</table>
| How many SMSs do patients remember to have received? | Questionnaire –based patient interview (Q8) | -Nr of patients ‘remembered half of the times’ (having received in last month >= 50% of planned DSMS (10 in DRC, Cam, 3 in Phil)  
-Nr of patients ‘remembered all of the times (having received almost all of planned SMSs in last month (>=20 in DRC, Cam, >=7 in Philippines) |
| **Did patients use their phone more frequently?** | Questionnaire –based patient interview (Q4) | Nr of patients having used the mobile phone several x per week or more in the past month |
| **Did patients start to use the phone themselves for diabetes?** | Questionnaire –based patient interview (Q5) | Nr of patients having sent/called themselves for diabetes in past month |
| **Did the routine programme start utilizing the phone to communicate with patients?** | Questionnaire –based patient interview (Q7) | Nr of patients receiving calls/SMSs from their routine care provider |
Results

Participants

The loss to follow-up was 11.9% in DRC, 14.5% in Cambodia and 64.6% in the Philippines. Reasons included migration (6 in Cambodia, 5 in DRC, 5 in Philippines), unwillingness (12 in Cambodia, 1 in DRC, 1 in Philippines), sickness (5 in Cambodia, 2 in DRC, 2 in Philippines), and death (15 in DRC, 4 in Cambodia, 2 in Philippines). There was a large loss of participants at the urban study site in the Philippines (N=136). Among the participants retraced, many indicated during an in-depth interview with the project manager, that they expected “no additional benefit” for continuing their participation in the study (not quantified – in depth interview with project manager Philippines). There were no significant differences in the baseline characteristics for those with complete follow-up and those lost.

The implementation of the DSMS intervention

An overview of the results separately for each country is given in table 3. Figure 2 shows the trend of the number of messages sent and received in 12 months in DRC and Cambodia. There was a gradual decline in the number of messages sent and received is confirmed by the project managers in both countries, who explained it was due to a delay in the development of new messages. It was difficult to continue frequent team meetings to prepare messages after the initial intense phase. Other temporary reasons for failures were technical problems with the Frontline software (Cambodia) in the third month and problems with the provider’s software resulting in network errors in DRC in month 5-6. In Cambodia, the network and provider-related errors increased over time, due to rapid changes at telephone companies, which affected the network quality of the selected provider. The project manager in the Philippines reported to have sent 87 messages to all participants under his responsibility in one year, which equals 7.3 per month (83.9% of the planned number).

A telephone check was carried out in DRC and Cambodia after 6-8 months, which revealed problems with 87 out of 253 users in the former and 78 out of 242 in the latter country. These ranged from phones being broken or lost, subscriptions being suspended or cancelled because of lack of credit, lack of charge, switched off. The emergence of new telephone companies, especially in Cambodia, led to people acquiring another mobile phone in addition to their project phone, which had cheaper rates, better network access or for other reasons. The result was that, they used this new phone more often, sometimes forgetting to check their project phone for functionality or new messages. The telephone checks in the Philippines were done through asking the participants to confirm by a reply-SMS periodically, at their own cost. The proportion of participants not replying varied from 25% to 50% at each check, but further inquiries by the project manager showed that most participants still possessed a working phone (exact numbers unknown).

To ensure the continuity of the intervention, subscriptions were renewed and phone numbers adjusted, and in Cambodia, negotiations started for a voice message system. In total, 312 different phone numbers were used in DRC, 262 in Cambodia, 298 in the Philippines. The total project expenditure per country for the intervention in the first year were 12,900 USD in DR Congo, 12,400 in Cambodia and 15,300 in the Philippines.

Participants being reached

The results, listed in table 3, are in line with the perceptions of the programme managers in DRC and Cambodia, as stated in the in-depth interviews. A random check in Cambodia revealed that 15-20% of the SMS stored in the phone memory had not (yet) been opened by participants. Their inboxes were also filled with many commercial or spam messages from mobile phone companies.
While the project messages were read less over the course of the project, people increased their overall usage of a phone (either project phone or other phone) after 12 months: people using their phone at least several times per week rose from 58.5% to 78.8% (p 0.000) in DRC, from 66.5% to 70.0% in Cambodia (p 0.5), from 56.7% to 83.5% (p 0.000) in the Philippines (of all people with 1 year follow-up completed). A number of the participants reported using their phone on their own initiative to call or send SMS for issues related to their diabetes: in DRC, the number of people reporting to have done so in the last month was 42 at baseline and 61 at year 1 (p 0.000), in Cambodia, 118 at baseline and 107 after 1 year (p 0.6), in the Philippines 32 at baseline, 7 at year 1 (p 0.000). They contacted most often their educator (in DRC 40 x, in Cambodia 83 x), followed by their doctor and other patients.

Apart from receiving the SMSs, participants also kept in touch with the educator of the routine programme. The educator also used the phone to reach patients, for instance to discuss results or to trace them after having missed a consultation. In DRC, 27 persons (11.2%) responded that they had contact at least once in the past month with their ‘educator’ (nurse, peer-educator of community health worker) via phone, in Cambodia this was 124 (51.7%), in the Philippines 8 (3.3%). The frequency of this contact was not high, on average only once or twice a month.

**Table 3. Results of process evaluation of mHealth intervention in DRC, Cambodia and Philippines**

<table>
<thead>
<tr>
<th>Implementation</th>
<th>DRC</th>
<th>Cambodia</th>
<th>Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nr SMSS/patient/month supposed to be sent: mean</td>
<td>21.7</td>
<td>26</td>
<td>8.7</td>
</tr>
<tr>
<td>Nr SMSS actually sent out/month/phone: mean (min-max)</td>
<td>15.7 (9.3-22.0)</td>
<td>24.7 (20.0-30.7)</td>
<td>7.3 (min-max n.a.)</td>
</tr>
<tr>
<td>Number of SMSS successfully recorded to be sent out per month per phone nr (range)</td>
<td>14.7 (7.3-22.0)</td>
<td>24.0 (18.9-28.0)</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patients &amp; coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients at start</td>
</tr>
<tr>
<td>Number of patients in Follow Up at year 1 (%)</td>
</tr>
<tr>
<td>Number of patients reporting still to have a phone (%)</td>
</tr>
<tr>
<td>Nr of patients remembered at least once (%)</td>
</tr>
<tr>
<td>Nr of patients remembered half of the times</td>
</tr>
<tr>
<td>Nr of patients remembered all of the times (%)</td>
</tr>
<tr>
<td>Nr of patients having sent SMS/called themselves for their diabetes in the past month (%)</td>
</tr>
<tr>
<td>Nr of patients receiving calls/SMS (outside of the intervention) from their routine care provider</td>
</tr>
</tbody>
</table>
Discussion

Main findings

The data show that there is a decline at each step in the process from planned intervention to effective coverage with large differences across the three countries. In the intervention process, the biggest drops were from planning to actual implementation (21.7 SMS per month to 15.7 in DRC, 26 to 24.7 in Cambodia, 8.7 to 7.3 in the Philippines). This was partly due to operational reasons on the side of project management (e.g. delay in the formulation of messages) and technical problems with either the messaging software or the network provider. Once the SMSs are delivered to the phone, it is still difficult to reach the participant. One third of all telephone numbers initially recorded was not reachable at a mid-term check, because of loss, switch-off or change of number. Even if phones are on, people don’t always open their inboxes to read their messages. In DRC, the decline in the number of patients contacted was the least: more than half remembered receiving (almost) all messages, two-third remembered receiving at least some. In Cambodia, the decline was larger: 60% of patients remembered some messages, but only 10% remembered receiving all. Quite some messages remained unopened in Cambodia and inboxes contained many spam messages. People also acquired other phones which made them to ‘forget’ the project phone.

In the Philippines, the intervention did not reach the participants as planned. The challenges were many. The loss of many participants to follow-up and the lack of process data from the Frontline software resulted in a small amount of data, which are difficult to interpret. The lower number of messages made the intervention more condensed. The high attrition rates in the urban site point to particular constraints. An important factor, apart from a problem in supervision due to the departure of the senior research staff, was that the routine DSME programme was delivered through a hospital based chronic care team, with community extension through the education nurse. It appeared more difficult for those nurses to retrace patients than in the rural sites, where village health workers are closer to their patients.

Unintended changes were observed in the context of the intervention and in the diabetes programmes. All patients increased their use of the telephone, both for general purposes as well as for diabetes management. Others, including health care providers, used the telephone more often to reach patients, for instance to discuss results or to retrace them. This was most clear in Cambodia. Reports about the general increase in mobile phone penetration and use confirm this observation, that the mobile phone has become more important in daily life. Since one of the aims of the TEXT4DSM study was to improve access to care and enablement of people with diabetes, these increased interactions between patients and health providers can be considered a positive ‘spin-off’.
Comparison with other research

The systematic reviews of mhealth interventions focus on outcome measures, less on process measures. The apparent contrary conclusions of two recent reviews about the potential effect of mhealth interventions on diabetes outcomes suggest that simpler interventions, using only mobile phone – mainly SMS - without other digital platforms, produce less or no effect [8,9]. An earlier review about mhealth interventions for behaviour change alluded to the fact that interventions that engage people in the process (patient-initiated communication, interactive messaging, more frequent messages, tailoring) lead to less attrition and thus to potentially more reach [13]. Process outcomes were poorly evaluated in most studies. There is great variability in participant compliance, response rate and acceptance of mhealth interventions across studies. We found only one publication about a two-way SMS intervention to influence self-management behaviour of people with asthma, reporting a response rate of 69% [25].

Our intervention was limited in scope and did not allow for much interaction and tailoring, which could explain the high attrition rate and the low uptake byf participants [13]. Our evaluation points to several barriers in the implementation, including those linked to technology adoption, to the commercial development of the telephone market and to the way people use their phone and read messages.

Limitations

Limitations to our study relate to the study design, data collection and data analysis. The content of the messages and the frequency of messaging was different in each country, due to the contextualisation process. These differences could also reflect differences in the quality of information conveyed to the target population, influencing their uptake. Both content and frequency differences can be potential confounders to the results presented. The process evaluation took place halfway through the two year intervention. Project managers and participants needed time to familiarize themselves with the intervention. In the second half of the project, adjustments have been made such as targeting subgroups and sending voice-messages in Cambodia, to reach more patients effectively. The particular problems in the Philippines with loss of follow-up and the lack of process data from Frontline software constrained the validity of the interpretations.

Although the diversification in sources is meant to reduce the influence of errors and bias, there are imperfections in the methods of both the technical data extraction and the use of interviews. The automated Frontline records comprised a small number of SMS and phone numbers, which were not part of the actual intervention, for instance invitations to come for the research interview and testing phone numbers of project managers, leading to a small overestimation of the telephone numbers used (1-3%) and SMS (0.01%). The data from the Philippines are subject to reporter bias.

The data collection from participants is based upon self-reporting and therefore liable to bias. The responses of participants about the messages they received represent only the one month preceding the interview, instead of an monthly average over the full 12 months’ period. This was done to minimize recall bias. Because of the steady decline in the number of messages sent over 12 months (figure 1), it is possible that the number of participants ‘being reached at least half of the times’ or ‘almost all times’ is higher, when the full 12-month project is considered.

Conclusions

To our knowledge, this is the first study that analyses the implementation process of an mhealth intervention in low income settings. It identifies barriers in coverage and uptake of a seemingly simple intervention, from the planning phase to the final step in the process, people
remembering the SMS they received. Implementation of the intervention meets constraints at every step in the process, which hampers the intervention achieving its maximum potential.

To understand the decline of coverage at every step, it is helpful to categorize barriers into a) technological barriers, b) context barriers, and c) participant barriers. Technological barriers are the limited potential of an automated messaging system, which is untargeted, not demand-driven and which is vulnerable to technical problems related to the provider system. A linkage with an electronic medical record system would greatly enhance the potential of targeting and personalizing messages. The following context barriers were identified as important. The increased commercialization of the mobile phone market resulted in phone numbers becoming a changeable commodity and to SMSs changing from a mere information source to a marketing tool. The subscription arrangements at the start of the project became a barrier to access as the telephone market evolved. Participant barriers comprise the way people keep and use a phone, read their messages, and process them into their memory. For instance, people not being able to read needed a family member to read out the SMS for them and for some participants, the amount of messages filling their inboxes daily was problematic.

The unintended consequences of the intervention show that the spin off effect of the intervention was wider than the mere message content. The phone turned into a more common mode of communication, patients and their care providers reported to increasingly use the phone to discuss diabetes matters.

These findings might help managers to better understand and plan the operationalization of mhealth. We put forward three recommendations for successful implementation. First, for the optimisation design and delivery of a mHealth intervention, adequate mobile technological capacity is needed, for instance to tailor delivery and to link different health and other information systems. Second, knowledge of the global and contextual telecommunication markets and advancements is important, to negotiate a sustainable business model, flexible enough to adapt to the rapid changes. Third, insights from behaviour science about how people use mHealth interventions are essential to design and deliver a project and to interpret the effects. mhealth is a technical tool, to support other mechanisms between a person with a chronic disease and their care provider and even within the person him/herself. Technology might be able to support interactivity, but only if it is actually reaching people. Further research questions involve a better understanding of why and how people act upon mhealth messages they receive, and what factors affect the acceptability of such messages to the intended recipients.

References


