

External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa

Final Tanzania mixed methods evaluation report

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Executive summary

The mNutrition intervention in Tanzania

mNutrition was a five-year global initiative supported by FCDO, organised by Groupe Spéciale Mobile Association (GSMA), and implemented by in-country mobile network operators (MNOs) and third-party providers. It sought to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. The nutrition content of the programme aimed to promote behaviour change around key dietary and child feeding practices likely to result in improved nutritional health within a household.

In Tanzania, mNutrition was implemented through the 'Healthy Pregnancy, Healthy Baby' (HPHB) SMS (text messaging) programme, which was part of the Wazazi Nipendeni mHealth platform. The programme was run by the mHealth Tanzania-PPP, which was initiated in 2012 by the Ministry of Health and Social Welfare, with financial support from the US Government's Centers for Disease Control and Prevention (CDC). Wazazi Nipendeni targeted pregnant women and mothers of young children, as well as their partners (husbands, etc.). It is available nationally and on all phone networks.

The HPHB SMS service sent free text messages in Swahili on a range of pregnancy and early childhood issues. Nutrition was a small component of the original HPHB SMS service but was extended substantially with the addition of the mNutrition content (approximately 300 nutrition messages). The resulting product will be referred to as Wazazi Nipendeni in this report.

Evaluation design

A consortium of researchers from Gamos, IDS, and IFPRI was contracted by FCDO to undertake an impact evaluation of Wazazi Nipendeni in Tanzania. The objectives of the evaluation were to assess the impact, cost-effectiveness, and commercial viability of the service. The field data collection for this evaluation covered the period from October 2016 until April 2019. The evaluation used a theory-based mixed methods approach with three interlinked components, as follows:

- A **quantitative impact evaluation** that employed a randomised control design to determine the causal effect of the programme on dietary diversity, infant and young child feeding (IYCF) practices, and child anthropometry. The quantitative team conducted large-scale household surveys at the start of the programme implementation and two years later, both in treatment communities, which received door-to-door offers to sign up to the service, and in control communities, which did not receive such offers but were still able to access Wazazi Nipendeni.
- A **qualitative impact evaluation**, which consisted of three qualitative data collection rounds (i.e. an initial qualitative exploratory study, in-depth case studies at midline, and a rapid explanatory qualitative follow-up study) and aimed to provide understanding of the context, underlying mechanisms of change, and implementation process of Wazazi Nipendeni.
- A **business model and cost-effectiveness evaluation**, which employed stakeholder interviews, commercial and end user data, document analysis, and evidence from the quantitative and qualitative evaluations to generate a business model framework and to estimate the wider imputed benefits from the value-added service (VAS) for the range of stakeholders involved.

The evaluation report presents the findings structured around the evaluation questions (see Section 4.1). It draws on evidence from each component to address each question as comprehensively as possible. This report deliberately presents the results in a way that is accessible to, and actionable for, non-technical audiences, including policymakers. In-depth technical and methodological details and discussions have therefore been excluded, but these are included in the detailed method-specific reports.

Main findings and recommendations

Effectiveness of Wazazi Nipendeni in reaching mothers and pregnant women

The evaluation found that the reach of Wazazi Nipendeni was lower than expected. This limited reach can be explained by shortcomings in the available supportive infrastructure (e.g. considerable gendered barriers to access to mobile phones in rural Tanzania, difficult electricity access, and multi-SIM-card behaviour with frequent loss of SIM cards), very limited sharing of the content of Wazazi Nipendeni, issues in the implementation (e.g. users never received Wazazi Nipendeni or the service was suddenly discontinued without obvious reason), and issues in the design of Wazazi Nipendeni (e.g. users mistook messages for spam because they had unclear sender details, lack of human support to encourage continuous engagement). Mobile phone-based services can also generate new inequalities: very poor mothers who could not afford a phone or had limited/no access to a phone were often excluded from the service. However, it should also be highlighted that both mothers and fathers who successfully received Wazazi Nipendeni messages usually read the majority of the messages. This suggests that the content of the Wazazi Nipendeni messages was not to blame for the low reach.

Based on the evaluation findings, to optimise the reach of a mobile phone-based advisory service such as Wazazi Nipendeni the following recommendations should be considered:

- The availability of supportive infrastructure is an important requirement to enable a mobile phone-based information service to effectively reach the intended target group in a chosen context. This includes sufficient autonomy of the target group over the access to a mobile phone (i.e. access is not controlled and restricted by the phone's owner) or ownership of a mobile phone (especially among women), and easy access to electricity to charge the mobile phone (without long down times due to lack of electricity or lack of money to pay for electricity). If these requirements are not met or are not met for a large proportion of the intended target group, alternative modes of content delivery (e.g. via radio or community outreach), or blended approaches (e.g. radio and community worker), may have a wider reach and be more inclusive.
- Tying a mobile phone-based service to one specific SIM card in a context in which people frequently manually switch between multiple SIM cards can pose a barrier to the effective reach of a mobile phone-based information service. This is because the rate of SIM card loss is often high and messages may be missed because another SIM card is in use. Enabling users to access the service using multiple SIM cards may increase long-term engagement.
- To ensure sustained engagement with a mobile phone-based service such as Wazazi Nipendeni it is important that users are made fully aware of the conditions of use (e.g. access to the service is linked to one specific SIM and MNO, and changing one or both of these will mean discontinuation of access to the mobile phone-based service). As part of this, users should also be informed how to re-subscribe to the service if they wish to.

- Text messages can be an effective delivery modality for information in contexts with high levels of literacy and one commonly spoken language (as long as the target group successfully receives the messages and there are no other barriers to overcome).
- Peer-to-peer sharing of the content could increase the reach of the mobile phone-based service considerably, including to mothers who are currently excluded (e.g. because they cannot afford a mobile phone or do not have access). However, the qualitative evaluation suggests that sharing does not happen frequently. Wazazi Nipendeni could experiment with approaches to actively encourage message sharing (e.g. by sending reminders to share and highlighting the benefits of sharing, such as better well-being of the entire community).
- In a context with high levels of unwanted mobile spam, a clearly identifiable sender name (e.g. 'Wazazi Nipendeni') can help prevent text messages from being mistaken for spam and thus being deleted without being read.
- Interpersonal contact with people who are perceived as credible (e.g. health workers) is important to build initial trust in a mobile phone-based service, and can motivate mothers/their households to sign up.
- Adding human support features to mobile phone-based services is likely to increase reach, long-term trust in the credibility of the messages, and sustained engagement. This could include interpersonal contact with promoters/outreach workers and implementation of a well-functioning expert call centre.

Impacts of Wazazi Nipendeni on nutrition outcomes

Based on the quantitative impact evaluation, access to Wazazi Nipendeni had small positive impacts on IYCF knowledge among men and women (statistically significant only among men; men answered 1.7 percentage points more IYCF knowledge questions correctly than control group males) and on dietary diversity among children and women (children aged 6–23 months were more likely to meet the minimum acceptable diet threshold by 6.9 percentage points and women were more likely to meet the threshold for minimum dietary diversity (MDD) by 3.9 percentage points). However, these positive impacts did not translate into an improvement in nutritional status among children. The limited impact of Wazazi Nipendeni can in part be explained by the low reach and very limited sustained engagement with the service, as well as the contextual barriers that prevented families from translating Wazazi Nipendeni advice into practice (most importantly, the lack of financial resources).

- To increase the impact of a mobile phone-based service such as Wazazi Nipendeni and enable poor families to act on the messages, the service should be joined up with other ongoing interventions that help poor families to deal with poverty (e.g. social protection programmes).

Despite these disappointing overall impact findings, quantitative and qualitative data suggest that mothers/fathers who had access to Wazazi Nipendeni made at least some changes in their IYCF and caring practices, as well as the foods they ate themselves and served to their families. The types of changes made varied greatly and depended on the financial circumstances, capacities, and contexts of the households.

The evaluation findings also suggest that offering Wazazi Nipendeni positively influenced females' and males' use of mobile phones. In particular, women (who often only had limited and closely monitored access to mobile phones in Iringa Region) were significantly more likely to have used mobile phones (e.g. women were more likely to make calls – by 5 percentage points). This suggests that services such as Wazazi Nipendeni might help to bridge the digital gender gap by

convincing husbands of the benefits of allowing their wives to access mobile phones more freely (i.e. to read Wazazi Nipendeni messages that, if acted upon, could benefit the well-being of the family).

Process of content development for Wazazi Nipendeni

The evaluation found high levels of overall acceptance of the content of Wazazi Nipendeni among the subsample of mothers/fathers that used the service. Overall, users perceived message content as easy to understand, useful, and relevant. They appreciated the non-judgemental tone of the messages and the fact that the content was tailored towards the specific stage of their pregnancy or age of the child. Messages were especially valued in contexts in which access to formal health and nutrition advice was limited (e.g. in contexts with overcrowded health facilities in which health workers have little time to provide advice) and by individuals who were excluded from formal services (e.g. due to work commitments or being unmarried). While the quantitative data suggest that both male and female users of Wazazi Nipendeni perceived the messages as relevant and useful, the qualitative data indicate that fathers' perceptions of the usefulness of the messages were mixed, with some men perceiving the messages as highly useful and others as not useful. Trust in the credibility of the content of the service was generally high. Nevertheless, not all content was perceived as equally relevant and the evaluation also suggests some potential areas for improvement:

- Most Wazazi Nipendeni users were interested in and receptive to practical, context-specific advice that complemented theoretical high-level advice that they had received from other sources (mainly government health workers). Given their financial constraints, content that recommended, for example, the purchase of animal-sourced foods and fresh fruit was often perceived as less relevant, as this was not an option that was available to many poor households. Future interventions should focus on providing practical, low-cost, and context-specific advice that is actionable and achievable within resource-poor contexts (rather than mainly reinforcing existing high-level, generic knowledge).
- While mobile phone-based messages might be an effective mode of delivery for information on IYCF practices, they cannot help users to develop the skills to put them into practice. For example, women usually need intensive and interpersonal support in learning optimal breastfeeding practices. Wazazi Nipendeni messages could be strengthened by actively encouraging mothers to visit health workers for support in developing skills. Another option might be to complement text messages with recorded video messages.
- The information needs of mothers and their families changed dynamically and they frequently looked for information that would help them to tackle individual, acute nutritional and health problems. Introducing two-way communication channels (e.g. a call centre or interactive dialogues) could enable mothers to actively seek the information they need at the time they need it.
- First-time parents and experienced parents with previous children have different information needs and gaps. To ensure that the Wazazi Nipendeni content is relevant for all types of parents, different sets of messages to address each group's specific needs should be considered.
- The content of the Wazazi Nipendeni messages needs to be updated regularly to remain relevant, reliable, and useful. Funding, as well as responsibilities, for regular content reviews and updates of the messages needs to be planned for from the beginning, in order to maintain a relevant service throughout.

- Messages that are tailored towards each stage of pregnancy and early childhood can inadvertently raise suspicion in contexts in which pregnancy and early childhood are perceived as private family issues. Similarly, poor tailoring of the content of, and badly timed, Wazazi Nipendeni messages may have quickly resulted in frustration with and disengagement from the service, as users perceived the content to be less useful and relevant. Careful and individualised profiling during the initial registration process and detailed explanation of the service (preferably by trusted individuals such as health workers) is vital to build trust and to ensure continued engagement.

Mobile phone-based services for behaviour change

Several features give mobile phones an advantage over ‘traditional’ channels for behaviour change communication:

- Mobile phones can provide tailored and time-sensitive information (e.g. specific information for each week during pregnancy) more effectively and with less effort than most other information sources, even in remote, inaccessible settings (as long as there is sufficient network coverage and access to mobile phones).
- Mobile phone-based text messages can convey sensitive information related to pregnancy and early childcare more privately than health workers often can do (especially in overcrowded health facilities with no space for private conversations). This is appreciated especially by first-time parents, who often lack the confidence to ask questions.
- Mothers often struggled with multiple demands on their time (including household, care commitments, and paid work outside the home) and were therefore unable to attend health clinics regularly (e.g. for child growth monitoring). Wazazi Nipendeni’s mobile phone-based information was valued as it could be read flexibly whenever and wherever mothers had time (as long as they had access to the mobile phone).
- Frequent Wazazi Nipendeni text messages satisfied mothers’ needs for continuous reassurance, support, and feedback from a credible, trusted source; this need could usually not be adequately addressed by public health workers, who saw mothers only infrequently and often worked under extreme time pressure. To ensure Wazazi Nipendeni messages effectively address mothers’ needs for continuous support (especially during critical times, such as shortly before and after birth or during initiation of breastfeeding) messages need to be sent out with a reliable frequency (e.g. several times a week).
- In a context of overcrowded and understaffed public healthcare services, mobile phone-based information services can offer a low-cost mechanism for reaching mothers (and fathers) more frequently. This can help to strengthen the existing healthcare system.

There was also one major shortcoming of Wazazi Nipendeni that would have to be addressed to increase its effectiveness for behaviour change:

- The transmission of text-based information to passive audiences without an element of interactive engagement is likely to have limited the effectiveness of Wazazi Nipendeni in changing behaviour significantly because users did not experience any peer, social, or emotional support when attempting to adopt the advice Wazazi Nipendeni provided. Social support has been shown to be critical in effective behaviour change interventions (especially for breastfeeding and other IYCF practices). Introducing interactive components into mobile phone-based services (e.g. a well-functioning call centre) and/or human support is likely to increase their effectiveness in decisively changing behaviours.

Other findings regarding the effectiveness of mobile phone-based services to change behaviours include the following:

- While Wazazi Nipendeni provided information tailored to users' specific needs (e.g. stage of pregnancy), the service did not support the generation of an enabling environment that supports parents willing to adopt new practices. To increase the effectiveness of mobile phone-based behaviour change interventions, they could be joined up with other ongoing interventions (e.g. livelihood improvement programmes or social protection programmes) or mobile money services that provide parents with the financial resources to act on the advice (e.g. buying animal-sourced food to feed to their children).
- Mobile phone-based advisory services such as Wazazi Nipendeni are unlikely to be effective as a stand-alone channel for behaviour change – they are likely to perform best when integrated with traditional media and channels as part of a multilevel strategy that conveys the same messages using multiple approaches (which Wazazi Nipendeni already does), as well as with a field presence. Mobile phone-based information could therefore be one part of a broad, many-pronged policy, and not the only component aiming to change behaviours and practices.
- Mobile phone-based information from a source that is perceived as credible (such as the government) can help to enhance mothers' bargaining power in intra-household spending negotiations by convincing fathers to take more responsibility in regard to childcare-related activities. Many fathers were more likely to listen to and engage with such requests from their wives as they perceived the messages to be sent by sources they respected. To further promote this mechanism of change, messages could (gently) promote the use of the Wazazi Nipendeni content in intra-household decision-making processes.

Commercial viability of business models for Wazazi Nipendeni

VAS providers are faced with a dilemma: to market a service themselves, often to institutions (B2B), making it available across all networks, or to enter into partnership with an MNO with national coverage, offering the potential to scale up by marketing the service to all network subscribers (B2C).

- The evaluation highlighted the importance of a long history of investment, partnerships, and political commitment in nurturing a facility to the point where it can successfully implement an information dissemination service (and other services) at national scale. Donors need to be aware of the importance of laying down a foundation upon which innovative services can be built.
- The ability to broker a complex set of partnerships with a diverse range of stakeholder groups has been crucial to the success of the service. These partnerships have been successful due, at least in part, to the personal skills and commitment of the mHealth Tanzania-PPP team.
- Field partners play a crucial role in providing a face-to-face presence that supports users by getting them registered, reinforcing messages, and enhancing the effectiveness of the service.
- The Wazazi Nipendeni service yields substantial indirect benefits to mobile operators in terms of increased average revenue per user (ARPU). The effect size was at least a 10% increase in ARPU (of 510 Tanzanian shillings (TZS) per month), and is likely to be higher still. This is possibly as a result of women becoming more confident in their use of phones. There was no evidence that Wazazi Nipendeni users held on to their SIM cards for longer (i.e. of reduced churn). MNOs provide zero-rated SMS as part of their corporate social responsibility, and yet they are getting an indirect benefit that gives them revenue exceeding their 'donation', even when that donation is assigned a retail SMS value.

- Given that MNOs are deriving real financial benefit from the partnership, further research is required to identify a mechanism whereby content created using public funds can be paid for through some form of revenue share of the financial benefit yielded by the services that exploit that content.
- Demonstrating that Wazazi Nipendeni generates real revenue for operators opens up possibilities for alternative commercial business models. Our analysis has focused on two hypothetical cases: a) replicating a mHealth agency, delivering a service similar to Wazazi Nipendeni, in another country (a MNO-led in-house mHealth service); and b) an independent content provider.
- An in-house mHealth service developed by a MNO appears to be the most attractive proposition for two reasons: first, all of the increase in revenue is retained by the MNO; and, second, the real cost to an operator of sending SMS messages is minimal. Modelling a scenario based on positive assumptions on operating costs, ARPU, and the effect size (increase in ARPU) indicates that a service could provide an internal rate of return (IRR) of approximately 70% over a four-year period.
- Less attractive, although possibly still viable, is an independent content provider model: the provider would need to pay a bulk SMS price for all messages sent, and it would need to share revenue with each participating operator. A scenario based on positive assumptions on operating costs, ARPU, the effect size (increase in ARPU), and revenue share (50%) indicates that a service could only provide a positive IRR over a six-year period. However, it is unlikely that an aggregator could convince an MNO to share 'increased ARPU' – as an indirect benefit, tracking and allocating this would be a challenge.
- In the event that a health information service provider is permitted to levy charges, possible mechanisms for revenue generation include charging non-governmental organisation (NGO) / government clients, the sponsoring of messages as a form of advertising (e.g. by fast-moving consumer goods companies), and commission from sales of private health sector financial products (e.g. life insurance).
- Telecommunications companies have come under pressure from the government as part of its anti-corruption campaign. Support for Wazazi Nipendeni has political capital in this context, and operators have now signed agreements directly with the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDEG), rather than indirectly with the mHealth Tanzania-PPP. Previously, operators' promotion of Wazazi Nipendeni has been weak so they should be supported to capitalise on Wazazi Nipendeni's positive brand.
- Despite the vulnerabilities in the current business model with regard to continued funding from CDC, and free SMS messages donated by MNOs, the model articulated by the mHealth Tanzania- PPP appears to be sustainable. The mHealth Tanzania-PPP continues to enter into agreements with new public health programmes, while recent policy documents suggest that continued donor funding is likely to be forthcoming. There may be merit, therefore, in continuing with the donor-funded business model as a means to achieve scale.
- Although SMS remains an appropriate medium for reaching women, data-based services may split the market. Emerging mHealth services exploit the potential of the internet, of smartphones, of data acquisition and analysis, and of mobile money services. This is consistent with trends in the telecoms market of growth in data and mobile money. mHealth services will therefore need to be agile as they incorporate emerging technologies into their service offering.
- The cost-effectiveness based on disability-affected life years (DALYs) averted, even with the most favourable assumptions, does not fit within the World Health Organization (WHO) guidelines for an acceptable intervention. Increases in revenue (ARPU) can be attributed to the service but these are received by institutions outside of the product development partnership

(i.e. by the MNOs). If this revenue could be shared with donors then cost-effectiveness could be improved; identifying a mechanism by which to do this would be an interesting subject for future research.

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List of abbreviations

ARPU	Average revenue per user
CDC	Centers for Disease Control and Prevention
DALYs	Disability-affected life years
FCDO	UK Foreign, Commonwealth & Development Office
G2C	Government-to-citizen
GAIN	Global Alliance for Improved Nutrition
GDP	Gross domestic product
GSMA	Groupe Spéciale Mobile Association
HAZ	Height-for-age z-scores
HPHB	Healthy Pregnancy, Healthy Baby
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
IRR	Internal rate of return
ITT	Intent-to-treat
IYCF	Infant and young child feeding
LATE	Local average treatment effects
MDD	Minimum dietary diversity
mHealth Tanzania-PPP	mHealth Tanzania Public–Private Partnership
MNO	Mobile network operator
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
NGO	Non-governmental organisation
O&P	Osterwalder and Pigneur
OPM	Oxford Policy Management
PPP	Public–private partnership
SMS	Short messaging service
TFNC	Tanzania Food and Nutrition Centre

ToC	Theory of change
TTC	Text to change
TZS	Tanzanian shillings
USAID	United States Agency for International Development
USSD	Unstructured supplementary service data
VAS	Value-added service
WAZ	Weight-for-age z-scores
WHO	World Health Organization
WHZ	Weight-for-height z-scores

1 Introduction to the mNutrition evaluation

1.1 Objectives of the report

This report constitutes the final report on the mixed methods evaluation of the mNutrition intervention in Tanzania. mNutrition was a five-year global initiative supported by FCDO since 2013, organised by GSMA, and implemented by in-country mobile network operators (MNOs) and third-party providers. mNutrition's goal was to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. mNutrition was implemented through existing mAgri and mHealth programmes in 12 countries throughout sub-Saharan Africa and South Asia.

In Tanzania, mNutrition was implemented through the HPHB SMS programme, also known as the Wazazi Nipendeni SMS programme. The nutrition component aimed to improve maternal knowledge and practices around nutrition during pregnancy and in the first year of the child's life, in order to enhance the effectiveness of the Wazazi Nipendeni health platform for improving nutrition.

A consortium of researchers from Gamos, IDS, and IFPRI was contracted by FCDO to undertake an impact evaluation of the Wazazi Nipendeni service in Tanzania. **The objectives of the evaluation were to assess the impact, cost-effectiveness, and commercial viability of the Wazazi Nipendeni SMS service.** The evaluation used a mixed methods theory-based approach with three interlinked components: quantitative randomised controlled trial, an in-depth qualitative study with multiple rounds, and a business modelling and cost-effectiveness assessment. Data collection for the evaluation covered the period from October 2016 until March 2019.

1.2 Aims and intended audience of the report

The aim of this mixed methods evaluation report is to combine the findings of the three components, in order to build a deeper understanding and gather lessons learned about best practices in the design and implementation of mobile phone-based information services to ensure: (a) behaviour change with regards to nutrition; and (b) continued private sector engagement in different countries.

This report deliberately presents the results in a way that is accessible to, and actionable for, non-technical audiences, including policymakers. In-depth technical and methodological details and discussions have therefore been excluded in the present document and instead are included in the detailed method-specific reports that can be found [here](#).¹

The primary audience for the evaluation results are FCDO staff working on health, nutrition, and digital interventions, along with other key stakeholders, including GSMA and its national members (including local MNOs implementing mNutrition services), national governments (in particular, ministries of health and agriculture), international agencies and donors, and community-level health/nutrition and agriculture extension workers.

¹ www.ids.ac.uk/projects/external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-and-south-asia-mnutrition-2/

The evaluation's communications strategy, developed during the inception phase of the project, laid out a set of goals, objectives, communication channels, and activities which have informed the basis of all communication activities undertaken to date.

The findings of this report were presented and discussed with key Tanzania programme partners and other wider stakeholders working on or interested in this area during a webinar in May 2020. Earlier findings from the evaluation fed into the design of the subsequent FCDO-supported GSMA programme and it is anticipated that the evaluation's final findings will inform ongoing implementation and design of future digital programmes.

1.3 Organisation of the report

Following the description of the Wazazi Nipendeni service and the theory of change (ToC) in Section 2, a brief description of the evaluation context is given in Section 3. Section 4 provides a brief overview of the evaluation methodology. Section 5 presents the findings of the evaluation, structured around the evaluation questions laid down in FCDO's terms of reference. For each question, key findings resulting from the integration of the results from all three evaluation components are provided, and lessons learned and recommendations for policy and practice are presented. Section 6 briefly revisits the ToC for Wazazi Nipendeni and considers the extent to which it (and in particular its underlying assumptions) has been validated by the evaluation. Section 7 discusses the findings of the evaluation drawing on the wider global literature on mobile phone-based interventions to change nutrition behaviours. In this section we also draw parallels to the evaluation of mNutrition in Ghana (Barnett *et al.*, 2020). The report ends with the conclusions in Section 8.

2 The mNutrition service in Tanzania: Wazazi Nipendeni

2.1 Description of the intervention

In Tanzania, mNutrition was implemented through the HPHB SMS text messaging service. The mass media programme accompanying the service was called Wazazi Nipendeni. Wazazi Nipendeni was a project funded by CDC, bringing together multiple partners who are contributing towards shared goals. Phase 1 of the programme, launched in 2012, was initially developed in coordination with the Tanzania Capacity Communication Project, a United States Agency for International Development- (USAID-) funded programme led by the Johns Hopkins Center for Communication Programs. Wazazi Nipendeni is one of several behaviour change communication programmes using methods as diverse as TV drama series, radio distance learning for community health volunteers, and several integrated mass media campaigns. The PPP was initiated by the Ministry of Health and Social Welfare,² with financial support from CDC.³ Wazazi Nipendeni is available nationally and on all phone networks.

The HPHB SMS service sent free text messages containing healthcare information to pregnant women, mothers with newborns, male supporters, and general information-seekers in Tanzania to drive health-seeking behaviour. The SMS messages were sent in Swahili. Originally, the messages were sent to women up to 16 weeks post-partum on a range of pregnancy and early childhood issues. Later, anyone interested in receiving healthy pregnancy information and appointment reminders could text the word 'Mtoto' (baby) to the short code 15001. During the enrolment process registrants received instructional messages, requesting them to indicate the woman's current week or month of pregnancy (or the age of the newborn baby). This process allowed recipients to receive specific text messages relevant to the time and stage of their pregnancy and age of their child.

The mNutrition programme supported mHealth projects in eight countries through the development of nutrition content, and GSMA assisted projects with product development, primarily through subscriber experience research and business intelligence support. Wazazi Nipendeni did not receive any direct financial support from GSMA. Nutrition-related content was a small component of the original HPHB SMS service but this was extended substantially with the addition of content contributed by GSMA under the mNutrition programme. mNutrition added roughly 300 nutrition messages, which were delivered to caregivers of children up to five years old. Messages provided information on diet/micronutrient intake during pregnancy, breastfeeding, complementary feeding practices, and care and feeding of young children. The resulting product is referred to as Wazazi Nipendeni throughout this report.

The nutrition content included in Wazazi Nipendeni in Tanzania was based on 42 factsheets containing information on key behaviours relating to early childhood nutrition. It was developed and

² This has since been renamed the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC).

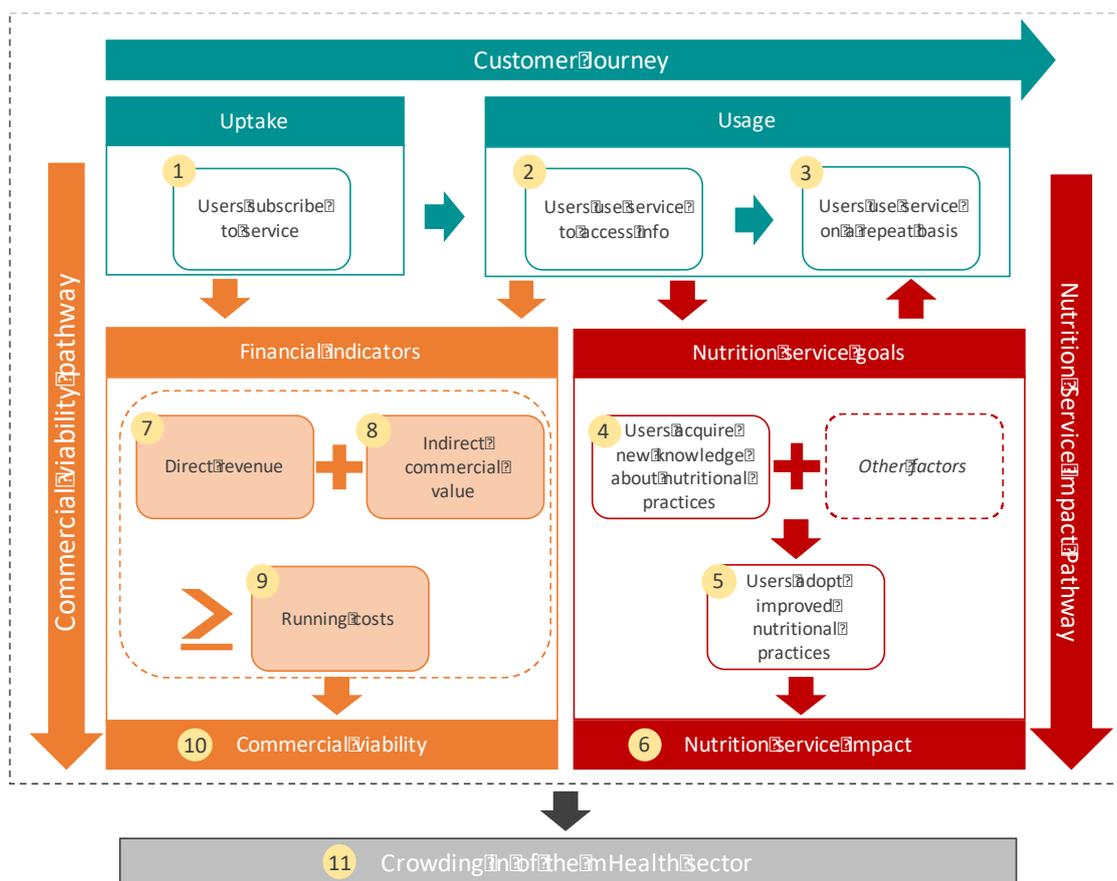
³ The Wazazi Nipendeni campaign and text messaging service is funded by the US Government through USAID, CDC, the US President's Malaria Initiative, and the US President's Emergency Plan for AIDS Relief. It is run in coordination with the National Malaria Control Programme, the National AIDS Control Programme, and the Health Promotion and Education Section. On the ground, health facility orientation support is also provided by the US Government, Aga Khan Health Services, and the Canadian International Development Agency. Other implementing partners include Jhpiego, EGPAF, the Mwanzo Bora Program, CCBRT, Tunajali Project, Plan International, and the Aga Khan Foundation.

adapted to Tanzania, and made mobile-ready by the Global Alliance for Improved Nutrition (GAIN), together with local partners and guidance from the Government of Tanzania. Messages were tied to the life-stage of the recipient household, and message frequency decreased as children got older.

2.2 How was Wazazi Nipendeni expected to improve nutrition outcomes and be commercially viable?

Figure 1 presents the generic ToC developed for mNutrition and as implemented through existing mHealth platforms (GSMA and Altai, 2017). The programme’s overarching ToC is that mHealth services offer access to mobile phone-based health and nutrition services while generating direct revenues and indirect commercial value. The mobile phone-based nutrition services are expected to increase pregnant women’s, mothers’, and other service users’ knowledge of nutritional practices that support good nutrition for their young children and for themselves. If users act upon this knowledge, this is expected to lead to improved nutritional practices, which may result in better nutritional status and health of pregnant women, mothers, or caregivers, and their children.

Figure 1: mHealth Theory of Change



Source: GSMA and Altai (2017)

2.2.1 Component 1: mNutrition customer journey

The first component is the **mNutrition customer journey** (depicted in blue in Figure 1), which consists of the following sequential stages (GSMA and Altai, 2017):

- uptake: awareness and subscription to the mNutrition service; and
- usage: use and repeat use, which leads to impact.

GSMA hypothesises that repeat users are more commercially valuable to mHealth service providers. They will generate more direct revenue for mHealth services, and will be more likely to adopt improved practices than low-level users – those who try the service only a few times or infrequently – because they access more SMS messages with information. They will be more likely to generate indirect commercial value for mobile operators for the following reasons:

- they stay with the operator providing access to this service (known as reduced churn);
- they like it (the service adds to the brand); and
- they spend money on other products and services with that operator (known as incremental upsell) – such as making more calls and sending SMS to friends and relatives.

GSMA hypothesises that there is a correlation between the extent to which customers use mHealth services and the likelihood that they will demonstrate improved nutritional information and practices – leading down the pathway to improved nutrition impacts in the ToC (GSMA and Altai, 2017).

2.2.2 Component 2: Nutrition service impact pathway

The second component of the ToC is the **pathway to nutrition service impact** (depicted in red). Once mNutrition users have access to the nutrition information, they are expected to gain new information about practices that can help them to improve their IYCF practices, women’s dietary diversity, and ultimately children’s nutritional status. Contextual factors are expected to support/enable the implementation of the new knowledge and users are expected to change their current nutritional practices and adopt new and improved practices. The intended result of the adoption is to improve nutritional practices, leading to improved nutrition. The primary outcomes that are the focus of this evaluation are improved IYCF practices, improved women’s dietary diversity, and improved nutritional status of children.

2.2.3 Component 3: Sustainable commercialisation pathway

The third component of GSMA’s ToC (depicted in orange) is the **sustainable commercialisation pathway**. mNutrition is a commercially viable service when the direct revenues of the service to the MNOs (meaning the revenues generated through the paid elements of the service) and indirect commercial value (meaning reduced churn, increased ARPU, and revenues generated through the purchasing of other services offered by the operator or through new customers attracted by the mNutrition service) are greater than the running costs of the service and provide an acceptable return on any capital investment made in setting the service up (GSMA and Altai, 2017).

2.2.4 Assumptions that underpin Wazazi Nipendeni

Table 1 presents the assumptions that lay behind each component of the ToC of Wazazi Nipendeni. The list of assumptions was developed by the evaluation team and was based on GSMA’s own monitoring and evaluation framework, the mNutrition logframe, the desk review, and the evaluation team’s experiences from previous impact evaluations of digital and behaviour change interventions. As part of this impact evaluation the underlying assumptions were explored and tested. Section 5 provides the key findings of this assessment.

Table 1: Assumptions behind the ToC of Wazazi Nipendeni

Customer journey	Nutrition service impact pathway			Sustainable commercialisation pathway
Uptake and usage of mNutrition	Uptake of new information	Adoption of new practices	Nutrition service impact	Commercial viability
Pregnant women and mothers can access mobile phones to subscribe to and use the service	Pregnant women and mothers have information gaps related to nutritional practices	Improved drinking water sources and sanitation are available	Pregnant women and mothers have access to fresh foods	mNutrition targets viable customer segments
Pregnant women and mothers can get sufficient network signal coverage and strength to subscribe to and use the service	Pregnant women and mothers lack access to credible information on nutritional practices	Pregnant women and mothers have access to and use antenatal care services	Contextual factors that may interact with nutritional practices and outcomes are not a barrier	The value proposition of the service satisfies the identified customer segments
Pregnant women and mothers are literate and comfortable with receiving SMS messages	Pregnant women and mothers perceive the information as credible and trust the information provided	Pregnant women and mothers have sufficient time and resources to improve child feeding practices		Channels for reaching the customer remain in place and customer relationships are able to reach and maintain the desired customer segments
Pregnant women and mothers have enough money to use the service	Pregnant women and mothers perceive the information as actionable and context-relevant	Pregnant women and mothers implement the nutrition advice correctly		Revenue streams (both direct and indirect) fulfil the key performance indicators required by the supply partners
Pregnant women and mothers have access to electricity to charge their mobile phones regularly	The information provided is accurate and correct	Pregnant women and mothers act on the new information and change their nutritional practices		Seeing the performance of the product, resources are made available from the key supply partners
There are no social norms or attitudes that may hinder pregnant women and mothers from engaging with mobile phone-based information services	Pregnant women and mothers understand the information provided (both	Other contextual factors support a change in nutritional practices (e.g. community)		Key partnerships in the supply chain are valued by each partner and maintained

	language and content)			
Unwanted mobile spam does not interfere with/distract from the mNutrition service		Pregnant women and mothers have the power to make decisions based on the advice received		A balance of cost, expenditure, investment, and income (both direct and indirect) makes for sustainable commercialisation of the product
Pregnant women and mothers find the service useful and use it repeatedly				Alternative approaches found in-country do not supersede the value proposition of the product
Service is successfully delivered to mothers'/pregnant women's mobile phones				

Source: Authors' own

3 Evaluation context: Tanzania

3.1 National level

The East African country of the United Republic of Tanzania has a population of 53.4 million (2015), with 68% of the population living in rural areas (UNdata, 2016). Tanzania was formed in 1964, shortly after achieving independence from the UK. It consists of Tanganyika (the mainland) and Zanzibar (an archipelago). The Tanzanian mainland is divided into 25 administrative regions, 113 districts, and 133 councils (CIA, 2020). Tanzania is a democratic republic and the constitution guarantees political pluralism. Tanzania is politically stable and in October 2015 held its fifth general election since it transitioned to a multi-party democracy in 1992 (CIA, 2014). Tanzania is an ethnically diverse country, with more than 120 languages; the national language is Swahili and the official language is English.

Tanzania is one of the fastest-growing economies in East Africa, mainly due to its natural resources and tourism. It has stable economic growth with an annual gross domestic product (GDP) growth rate of 7% in 2015 and a low inflation rate of 5.6% in the same year (World Bank, 2015).

The Tanzanian economy depends heavily on agriculture, which accounts for slightly less than one-quarter of GDP, and employs about 67% of the workforce (CIA, 2020). The main agricultural export commodities include coffee, cashew nuts, and cotton (CIA, 2020).

Despite promising economic growth and the government's vision of Tanzania becoming a middle-income country by 2025, poverty levels remain unacceptably high (United Nations Development Programme, 2014). The Household Budget Survey 2012 estimated that 28.2% of the population of Tanzania were poor, including 9.7% extremely poor (United Nations Development Programme, 2014). Poverty is estimated to be more prevalent in rural areas (30% of all households) than in urban areas (22%) (World Bank, 2015).

Tanzania's main development priorities (according to the Tanzania Development Vision 2025) include increased agricultural productivity, good governance and political stability, investment in good health systems, raising education quality, increased access to water, and improved availability of electricity (CIA, 2020).

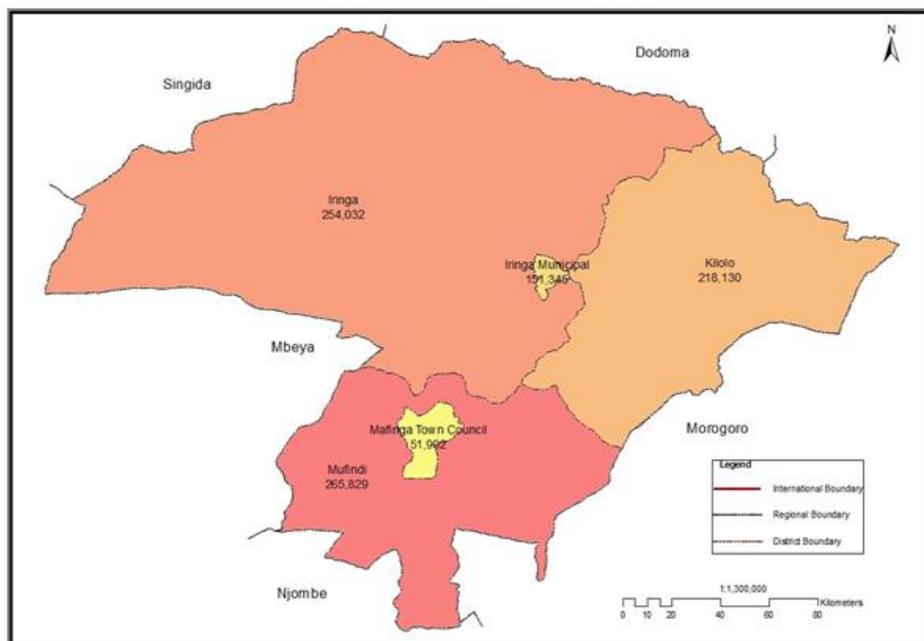
Despite good progress in health, undernutrition remains a public health challenge in Tanzania. Childhood stunting levels are high, and so are micronutrient deficiencies (especially Vitamin A, iron, and iodine). Thinness affects 5.5% of all women aged between 15 and 49 years in Tanzania and about one-third are deficient in iron, Vitamin A, and/or iodine. Overweight is also an increasing health concern, with more than 20% of women in rural areas being classified as overweight (United Nations Children's Fund, 2016).

3.2 Regional level – Iringa

Iringa was selected as the study region for the evaluation because Wazazi Nipendeni had no existing relationships with health clinics or NGOs in this region. The impact evaluation was conducted in two districts of Iringa: Mufindi and Iringa Rural. Iringa Region consists of five districts in total – Iringa Rural, Iringa Municipal, Kilolo, Mufindi, and Mafinga Town (see Figure 2). Iringa

Municipal and Mafinga Town have no rural component. Iringa was established in 1964 from the Southern Highland Province. Mufindi and Kilolo were created from the Iringa District in 1970 and 2006, respectively.

Figure 2: Map of Iringa Region



Source: Tanzania Regional Planning Office (2015)

Table 2 compares the characteristics of Iringa and Tanzania at a national level. Literacy rates in Iringa are higher (81%) than the national average (71.8%), but rates of stunting in children aged 0–59 months are significantly higher in Iringa (51.3%) than the national average (35%), despite relatively high early initiation and exclusivity of breastfeeding rates (75.5% and 62.7% in Iringa compared to 50.5% and 41.8% nationally).

Table 2: Regional and national characteristics of Tanzania

	Iringa	National (mainland)
Population*	1.1 million	54.2 million
Poverty head count (%)	29**	28**
Urban population (%)	27^^	34**
Literacy level** (%)	81	71.8
Nutrition indicators (%)		
Child underweight* (weight-for-age (WAZ))+++	18.2	15.8
Stunting (children 0–59 months) +++	51.3	35.0
Overweight+++	4.1	3.6
Early initiation of breastfeeding+++	75.5	50.5
Exclusive breastfeeding (0–5 months) +++	62.7	41.8
Women's health indicators		
Women received antenatal care from skilled provider***	99.4	97.9
Women delivering at a health facility*	80.4	50.2
Women (aged 15–49) with anaemia^	21.6	48.4

* National Bureau of Statistics: Project figures based on 2012 population and Housing Census

** National Bureau of Statistics: 2012 Population and Housing Census

*** <https://dhsprogram.com/pubs/pdf/FR321/FR321.pdf>

+ <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>

++ <https://data.worldbank.org/indicator/SI.POV.DDAY?locations=TZ>

+++ <http://tanzania.opendataforafrica.org/TZSOCECD2016/social-economics-of-tanzania-2016?region=1000120-iringa&indicator=1001300-population-size-number>

^ www.who.int/vmnis/anaemia/data/database/countries/tza_ida.pdf?ua=1

^^ <http://citypopulation.info/php/tanzania-admin.php?adm1id=11>

Source: Authors' own.

4 Evaluation methodology

4.1 Evaluation questions

The main objectives of this evaluation are to assess the impact, cost-effectiveness, and commercial viability of the Wazazi Nipendeni SMS service. In line with these objectives, the evaluation has addressed the following evaluation questions⁴:

1. How effective are mobile phone-based services in reaching mothers and pregnant women in Tanzania, and especially extremely poor women?
2. What are the impacts of Wazazi Nipendeni on nutrition outcomes (including knowledge and behaviours), especially among extremely poor women?
3. Has the process of adapting globally agreed messages to local contexts led to content that is relevant to the needs of poor mothers and pregnant women and their families?
4. What factors make the mobile phone-based Wazazi Nipendeni service effective in promoting and achieving behaviour change (if observed), leading to improved nutrition outcomes?
5. How commercially viable are the different business models for a mobile phone-based platform such as Wazazi Nipendeni? And how cost-effective is Wazazi Nipendeni?

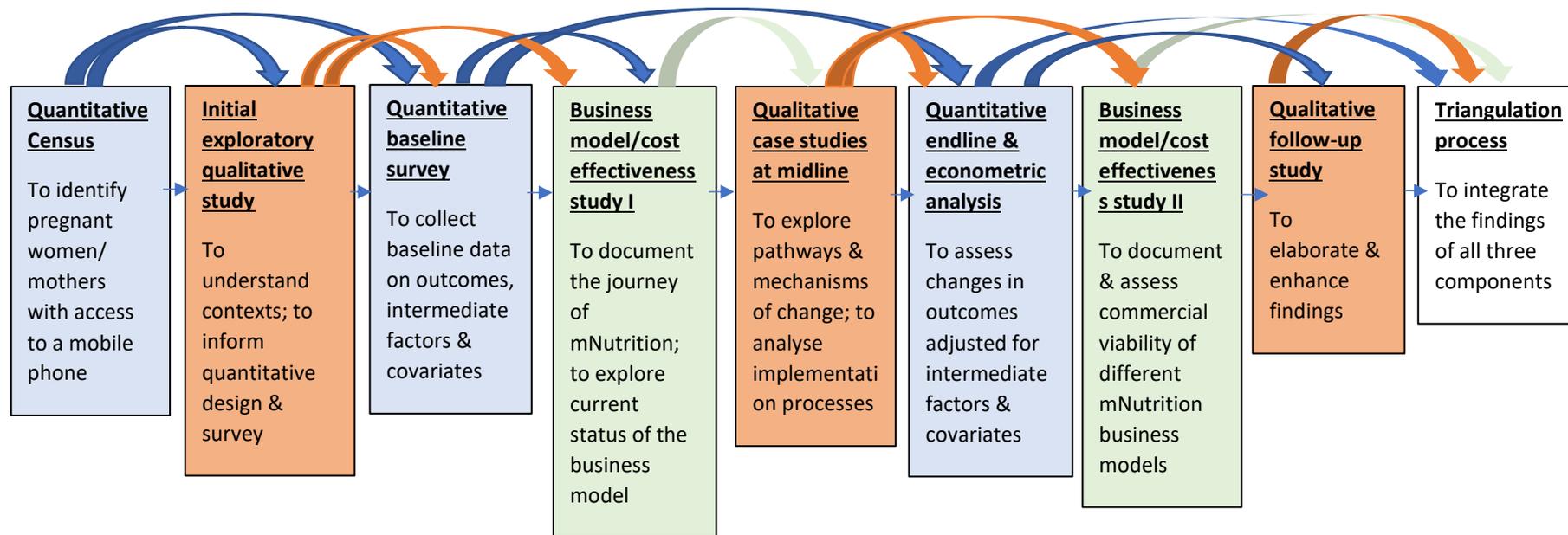
As an overarching aim the evaluation also set out to build a deeper understanding and to gather lessons learned about best practices in the design and implementation of mobile phone-based information services to ensure: (a) behaviour change; and (b) continued private sector engagement in different countries.

4.2 Evaluation approach

The evaluation has used a theory-based sequential mixed methods approach (Creswell *et al.*, 2003), including quantitative, qualitative, and business model and cost-effectiveness components. The three evaluation components were closely linked and integrated with each other at all stages of the evaluation to inform, enhance, and explain the design of, development of data collection tools for, and analysis of each individual component (see Figure 3).

⁴ These evaluation questions are in line with the original FCDO terms of reference. However, the questions have been slightly modified to reduce repetition, and have been reorganised and specified to Wazazi Nipendeni (rather than applying to mNutrition in general).

Figure 3: Visual depiction of the sequential mixed methods design used for the evaluation



Source: Authors' own

In the following sections, each evaluation component will be briefly described. The detailed methodology for each component, including sampling strategies and data collection tools used, as well as details of how the components were integrated for each data collection and analysis activity, can be found in the technical reports.⁵ The evaluation consortium was led by three institutions, with each one leading on a different component, in partnership with local data collectors. IFPRI led the quantitative component, IDS led the qualitative component, and Gamos led the business model and cost-effectiveness component. OPM Tanzania carried out the quantitative baseline and endline surveys and the three rounds of qualitative data collection. Gamos conducted its own data collection. The teams from each lead institution collaborated throughout the evaluation, with regular team calls, meetings, and workshops to share and discuss draft data collection tools, triangulate emerging findings, and decide jointly about any adaptations to the design required to ensure a coherent and triangulated mixed methods approach.

IDS took the overall leadership of the management and implementation of the evaluation. FCDO, GSMA, the local programme implementing partners and other key stakeholders were consulted and involved at key points during the evaluation design and implementation, and the evaluation team shared all draft reports with them for comments.

All consortium partners followed rigorous international and country-level ethical approval processes and procedures to ensure data collection was conducted in a professional and ethical manner with respect for confidentiality, voluntary participation, impartiality, and avoidance of personal risk.⁶

4.2.1 Quantitative component

Our quantitative impact evaluation employed a cluster randomised controlled trial to identify the causal effect of the service on nutrition knowledge, IYCF practices, women's dietary diversity, and the nutritional status of young children. Surveyed households in villages randomly assigned to the treatment group were offered access to the Wazazi Nipendeni content on a mobile phone, free of charge, through a door-to-door in-person visit during a promotion campaign coordinated by the study team; households in villages randomly assigned to the control group did not receive any offer of access to the service through the study's promotion campaign. However, households in both groups could have learned about the service through other means, including through other promotional activities run by the HPHB team and its partners.

The quantitative evaluation design included other components to provide evidence on factors affecting take-up and use of the service. In addition to the village-level randomisation, the evaluation included a second-stage household-level randomisation among eligible households in treatment villages to help understand how nutrition information flows between spouses. For households in treatment villages where both the pregnant woman (or the mother of the child under 12 months) and her spouse owned distinct mobile phones at baseline, the evaluation team randomly assigned half of the households to receive the Wazazi Nipendeni service only on the phone of the female household member, and the other half of the households to receive the Wazazi Nipendeni service on both the phone of the female household member and that of her

⁵ www.ids.ac.uk/projects/external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-and-south-asia-mnutrition-2/

⁶ These principles were guided by the Organisation for Economic Co-operation and Development's (2010) Development Assistance Committee Quality Standards for Development Evaluation and FCDO's (2011) Ethics Principles for Research and Evaluation.

spouse. Comparing outcomes between these two sub-treatment groups and the control households that would have been eligible for the sub-randomisation allows for the exploration of whether sending the information to multiple household members differentially affects household beliefs and behaviours related to nutrition.

Data collection and sampling strategy

Quantitative data collection took place in the three rural districts of Iringa Region, with 180 villages being randomly sampled from the 354 rural villages across those districts. In each village, an enumeration team listed all households to identify eligible households. Households were eligible to participate in the study if they had a pregnant household member or a mother of a child under 12 months of age, at least one household member was literate in Swahili, and the household owned at least one mobile phone. Only the first constraint was binding: 94.7% of the households with a pregnant woman or a mother of a child under 12 months of age also met the other criteria. 3,060 eligible households were sampled: six households with a pregnant woman and 11 with a mother of a child under 12 months, per village.

The baseline survey was conducted in March–April 2017, before the extra encouragement was implemented, and the endline survey took place between October and December 2018.

Data analysis

The impact of the Wazazi Nipendeni service on the primary and secondary outcomes can be estimated in two ways, both of which were applied by the evaluation. The main estimates are based on the comparison of outcomes across households in villages that were randomly assigned to receive the offer of access to the Wazazi Nipendeni content during the study's promotion campaign - known as the treatment group - and households in villages that were randomly assigned not to receive that offer - the control group. These intent-to-treat (ITT) estimates measure the impact of the offer of access to the Wazazi Nipendeni service on outcomes. ITT estimates are the preferred measures of service impact as they rely only on the random treatment assignment to accurately characterise the mNutrition benefits. In addition to the ITT estimates, the evaluation calculated the local average treatment effects (LATE) on compliers, which under additional assumptions approximate the impact of receiving the Wazazi Nipendeni messages on outcomes for households that were induced to receive the Wazazi Nipendeni content by the random door-to-door offer ('compliers'). Although the LATE estimates offer an appealing alternative representation of the impacts, they require an accurate measure of exposure to the mNutrition service in order to be valid. Measuring exposure to the Wazazi Nipendeni programme or use of the service at the household level was challenging. Survey respondents often did not know whether SMSs they received came from the Wazazi Nipendeni service. Both ITT estimates and LATE estimates are policy-relevant: ITT measures the causal effect of the random offer for the sample population, while LATE measures the causal effect of service participation for compliers. However, low sender and message salience imply that self-reported exposure is likely to understate people's true exposure to the programme. As a result, the self-reported difference in take-up between treatment and control households is likely to be smaller than the true difference in take-up, and the LATE estimates will then be larger than they should. We therefore prefer the ITT estimates, which are not reliant on accurate self-reporting of exposure to the programme in order to capture the causal impact of the offer of access to the service.

4.2.2 Qualitative component

The qualitative impact evaluation was closely integrated with the quantitative component and the business model/cost-effectiveness component at all stages, to inform, enhance, and triangulate the design, data collection, and analysis. The selection of sites and participants for qualitative data collection was purposive and was a subsample of the quantitative treatment sites (no qualitative data collection was conducted in comparison communities). Qualitative data collection was limited to the quantitative treatment communities in order to use the available resources to provide in-depth information on the experience with the intervention among users. Three qualitative data collection events took place: an initial exploratory study, midline case studies, and rapid follow-up studies after the quantitative endline.

The qualitative evaluation workstream aimed to provide an understanding of the context within which mNutrition was embedded, and which might have facilitated or hindered the uptake of the intervention. The qualitative impact evaluation also explored the underlying mechanisms of change in response to the intervention and assessed implementation processes (from the treatment communities' point of view).

Initial exploratory qualitative study

A comprehensive contextual analysis of the social, institutional, political, and environmental factors was carried out prior to the quantitative baseline in 2016. The analysis focused on:

- the acceptability, familiarity, and use of mobile phone technology;
- factors that may affect the operation and/or access to a mobile phone and to mobile phone-based behaviour change messages by the target group;
- current information-seeking behaviours related to nutrition and agriculture; and
- social, economic, and environmental factors that may influence the uptake of behaviour change messages provided by mNutrition.

A purposive sample of six communities was chosen from within Iringa Region. Participants within these six communities were then purposively sampled to illustrate the characteristics of different relevant sub-groups. Participants included pregnant women, mothers of children under two, fathers of children under two, health experts, elderly women, mobile kiosk operators, and village chairmen. In total, 28 in-depth interviews and key informant interviews and 12 focus group discussions were conducted.

In-depth case studies at midline

The qualitative midline in-depth case studies that were conducted in 2017 had three objectives: 1) to document the implementation of Wazazi Nipendeni at community level; 2) to explore the acceptability of Wazazi Nipendeni at household level; and 3) to explore potential changes in key behaviours related to child and maternal nutrition.

Multiple data collection tools were used so that data were obtained from different sources and perspectives, allowing for triangulation within the qualitative findings. At community level, the main data collection tools were semi-structured in-depth interviews with treatment mothers and fathers (i.e. mothers and fathers who were signed up to receive Wazazi Nipendeni messages by the OPM Tanzania team during the quantitative baseline survey), key informant interviews, and focus group discussions with treatment mothers and fathers and elderly women. Elderly women were interviewed as they are an important information source in relation to child nutrition in rural

Tanzania. At national level, stakeholder interviews were conducted with programme stakeholders involved in implementing the mNutrition programme. As part of the treatment group we also interviewed nine couples within which both spouses received Wazazi Nipendeni messages.⁷

Selection of sites was purposive and based on the quantitative baseline data. Two sites were selected to represent 'typical communities' in terms of poverty and exclusion, while a third was selected to present an 'extreme community' (in terms of geographical location and access to services).

Rapid qualitative follow-up studies

The third and final round of qualitative data collection conducted in early 2019 was narrower in scope than the previous two rounds, with its main objective being to explore some of the issues and impact areas highlighted in the previous rounds of the evaluation as requiring more depth and exploration. More specifically, the qualitative follow-up study aimed to: (1) identify the underlying reasons for sustained or continuous engagement with Wazazi Nipendeni in a context within which most mothers had disengaged with the service; and (2) explore pathways by which Wazazi Nipendeni services promoted change in IYCF practices and dietary diversity (among children and mothers).

The qualitative endline data collection took place in three sites across two districts in Iringa (two in Mufindi District and one in Iringa Rural). The sites were selected based on the quantitative endline data and only included treatment villages. The focus of participants selected was on the subgroup of treatment mothers who were still signed up and actively using Wazazi Nipendeni, and the subgroup who had used Wazazi Nipendeni for at least 12 months continuously but who no longer used the service.

A total of 57 in-depth interviews were conducted with long-term Wazazi Nipendeni users who were still active (n=22) and with long-term Wazazi Nipendeni users who were no longer active (n= 35) from across 21 villages.

Data analysis

The qualitative data were analysed using a directed content analysis approach that focused on the main qualitative evaluation questions. Data analysis started with open coding of several interviews and the development of an initial coding scheme that guided the coding of the remaining data. To increase the rigour of the data analysis, coding was done by two UK-based researchers independently and coding schemes were then discussed and merged into a joint scheme. While the coding scheme guided the coding, it was flexible enough to allow for topics that emerged to be added at any point.

4.2.3 Business model and cost-effectiveness component

The business model and cost-effectiveness evaluation considered organisational factors affecting the financial sustainability of the service. These business model insights addressed the research question 'How commercially viable are the different business models being employed at country level?' and provide a basis for assessing the cost-effectiveness of the service.

⁷ This is also a sub-group (n=138 couples) in the quantitative impact evaluation.

The component used the Osterwalder and Pigneur (O&P) framework (2010) for structuring insights into the business model. This framework was chosen because in addition to considering customer characteristics, such as why customers will buy the product or service (the value proposition), different types of customers, customer services, and revenue generation, it also considers organisational functions, such as activities, resources, and costs. This framework is particularly helpful for analysing the contributions and interdependencies inherent in a complex partnership model, such as that involved in delivering the Wazazi Nipendeni service. On the financial side, it considers both revenues (and pricing) and costs. This approach has limitations in the case of Wazazi Nipendeni, given that the mHealth Tanzania-PPP is not run as a business and consumers do not pay for the product, but the framework still works well for systematically considering ways in which the PPP functions.

The O&P framework is useful for taking a snapshot of the business model, which was done at the baseline stage. No business model remains static, as organisations respond to changes in context and circumstances, and the business model and cost-effectiveness component has augmented the baseline business model assessment with both changes that have occurred and additional detail gathered during the course of the assignment. Details on the updated business model have been drawn from findings from both the quantitative and qualitative studies.

In particular, more detailed information on users and cost structures has been obtained during the study. This has provided cost estimates that have been used as the basis for the cost-effectiveness analysis. It is difficult to argue a case for the financial viability of the mHealth Tanzania-PPP because none of the partners generates revenue directly by providing the Wazazi Nipendeni service. A financial model has therefore been created to explore the financial viability of hypothetical commercial scenarios that could deliver a similar service.

The evaluation documented the history of the service, covering not only changes that have taken place during the assignment but also the back story of the growth and evolution of the mHealth Tanzania-PPP, which provides a context for some of the decisions implicit in the business model.

The cost-effectiveness analysis proposed that it would be based on estimates of both costs and benefits (expressed in DALYs averted), derived from findings from the quantitative study.

The component has employed stakeholder interviews, commercial and evaluation data, and document analysis to estimate the wider imputed benefits from the VAS for the range of stakeholders involved. The analysis has been based on a range of activities:

- Country visits to establish and maintain relationships with key stakeholders. Interviews conducted with key representatives of stakeholder institutions to gather additional data to populate the O&P framework. Ongoing communication and country visits undertaken to monitor developments in services and to track the commercial justification for changes.
- Populating the O&P framework with information gleaned from reports previously published under the mNutrition programme (e.g. user experience testing, case studies, rapid feedback surveys, etc.), as well as grey literature.
- Working with IDS and IFPRI to contribute to the design of both the qualitative and quantitative instruments (both baseline and endline) to incorporate indicators relating to non-financial attitudes of customers to services, and to MNOs in particular, such as customer satisfaction and brand loyalty.
- Interviews with alternative service providers to explore different business models (among alternative mobile services).

- Analysing the impact data from the quantitative report and utilising the Global Burden of Disease and Lives Saved Tool (LiST) models, as well as other related literature and databases for Tanzania, to convert the impact into DALYs.
- Analysing financial and user data with a view to creating a financial model to test key cost sensitivities.

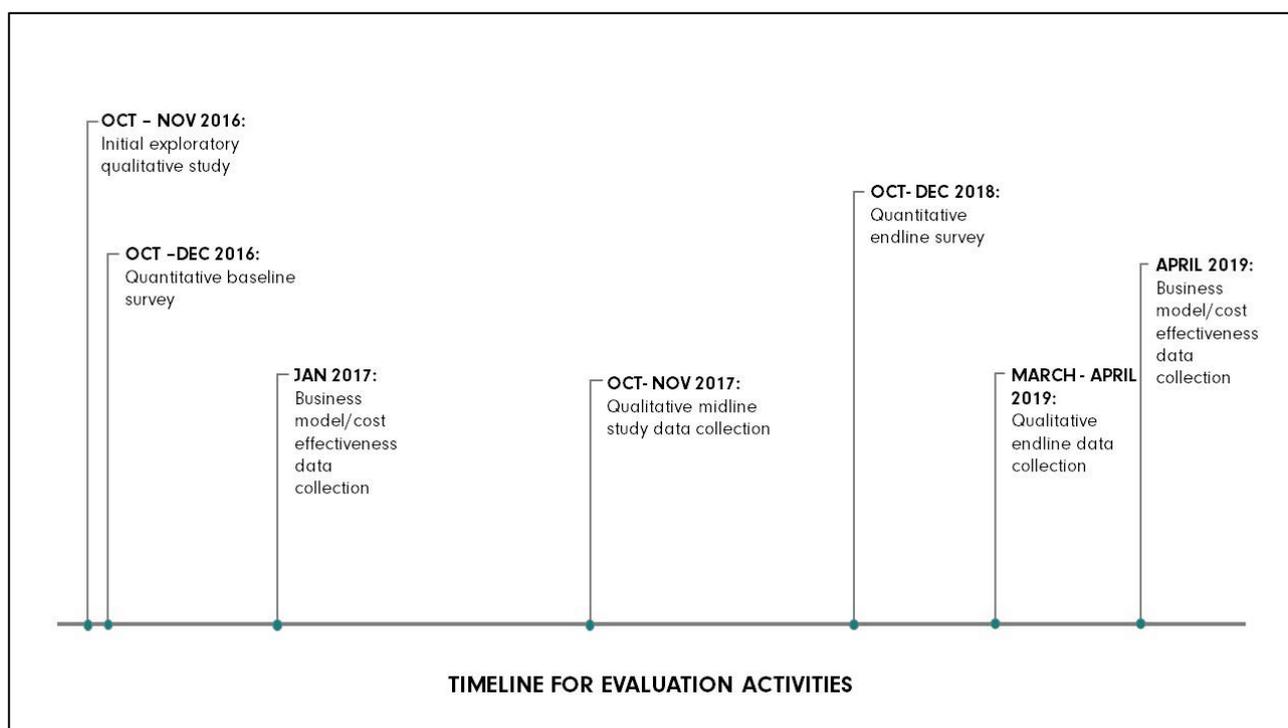
4.2.4 Mixed methods analysis and integration

The three evaluation components are closely linked and integrated with each other at all stages of the evaluation to inform, enhance, and explain the design, the development of data collection tools, and the analysis of each individual component. The different approaches are thereby used in a sequential manner (Creswell *et al.*, 2003).

We employed a pragmatic approach (see, for example, Johnson and Onwuegbuzie, 2004; Morgan, 2013; Yardley and Bishop, 2008) for the mixed methods analysis and integration. Contributions of all three evaluation components were thereby equal and no methodological approach took the lead (except in the section on the commercial viability of the business model; see Section 5.5.4). During the integration we were primarily guided by the main evaluation questions and the desire to produce useful insights and learning for future programming, independent of the methodological origin of specific findings. We consulted findings in an iterative manner, going back and forth between the different approaches in a dynamic manner and deepening the analysis wherever possible.

4.3 Evaluation timeline

Figure 4 summarises the impact evaluation activities in Tanzania, which ran from October 2016 to October 2019. Data collection started with the initial exploratory qualitative study in October 2016, followed by the quantitative baseline data collection in October–December 2016. The first business model data collection took place in January 2017. Sign-up for the mNutrition service took place shortly after the quantitative household visit, after the administration of the household survey. The qualitative midline took place in October – November 2017. The quantitative endline survey was conducted in October – December 2018. Finally, the qualitative follow-up study and final business model data collections took place in March – April 2019. A list of all the outputs from this impact evaluation can be found in Annex A.

Figure 4: Timeline of evaluation activities during the implementation phase

Source: Authors' own.

4.4 Limitations of the evaluation

This section outlines the main limitations of the evaluation.

- 1. Low take-up of Wazazi Nipendeni:** Take-up of Wazazi Nipendeni and sustained engagement with the service was unexpectedly low. This had consequences for the impact evaluation design, requiring the evaluation team to respond and adapt repeatedly (e.g. to adapt the qualitative sampling strategy).
- 2. Data access challenges:** Accessing business and, in particular, user data has been a persistent challenge for the impact evaluation team. Although stakeholders expressed a positive intent to share data, this did not always happen. GSMA emphasised the sensitivities surrounding data and did its best to negotiate data access with stakeholders. Sensitivities among the major mobile operators, along with structural changes and turnover of staff, made it difficult for GSMA and the study team to build relationships with MNOs. Changes in relationships and personnel (among all stakeholders) were the principal threats to data access. The mHealth Tanzania-PPP team was instrumental in securing the data used in the report.
- 3. External validity:** While the randomised design ensures the internal validity of the quantitative study (i.e. that our impact estimates are not biased within our study sample), the external validity may be compromised. Firstly, it should be highlighted that the independent mixed methods evaluation focused only on two mNutrition projects (Vodafone Famers Club in Ghana and Wazazi Nipendeni in Tanzania) and the findings may not reflect the performance of the overall mNutrition initiative. Secondly, the quantitative experimental design actively signed up mothers/households in the treatment sites to take up Wazazi

Nipendeni. Consequently, our treatment mothers were not ‘typical’ Wazazi Nipendeni users but included a wider variety of mothers (including many who might not have signed up for the product in a real-world context). However, we believe that this approach helped us to increase the external validity and transferability of the evaluation findings as it allowed us to assess the effectiveness of the mobile phone-based services for a broader and more diverse audience. We also complemented the experimental quantitative trial with multiple qualitative data collection rounds to gain in-depth insights into the impact of ‘context’ on the implementation and outcomes of Wazazi Nipendeni. A thorough understanding of how the context interacted with and/or facilitated or hindered the reach, uptake, and effectiveness of the service is particularly relevant to the transferability of the results and the lessons learned to other mNutrition projects.

5 Findings

5.1 Effectiveness of Wazazi Nipendeni in reaching mothers and pregnant women

This section answers the evaluation question: How effective are mobile phone-based services in reaching mothers and pregnant women in Tanzania, and especially extremely poor women?

5.1.1 Recap of the intended target group of Wazazi Nipendeni

The programme is run by the mHealth Tanzania-PPP, which was initiated in 2012 by the Ministry of Health and Social Welfare (now known as MoHCDGEC), with financial support from CDC. Wazazi Nipendeni is targeted at pregnant women and their partners (husbands, etc.) and mothers/caregivers of children under five. It is available nationally and on all four partnering phone networks.

5.1.2 Limited reach of Wazazi Nipendeni in the treatment sample

The reach of a programme usually refers to whether and how the intended target groups took up, engaged with, and used an intervention or programme (Glasgow and Linnan, 2008). The concept of reach is particularly salient for Wazazi Nipendeni, as impact, cost-effectiveness, and commercial sustainability are highly dependent on the total number of mothers and pregnant women who used the mobile phone-based service (McNamee *et al.*, 2016).

Based on the quantitative endline survey, the reach of Wazazi Nipendeni was low in the treatment group. To ensure successful registration, the quantitative team facilitated the onboarding process for Wazazi Nipendeni in the treatment households. The team offered a subscription to Wazazi Nipendeni in all treatment households at the end of the quantitative baseline data collection. A total of 99.6% of treatment households gave consent to be registered with Wazazi Nipendeni. The quantitative team sent at least one telephone number from each of these households to complete the registration for Wazazi Nipendeni. Nevertheless, only 66.4% (n= 847) of treatment households reported having received nutrition-related automated SMS messages during the preceding two years, and only 42.7% (n=545) reported having ever received nutrition content from Wazazi Nipendeni or the 15501 number that corresponds to Wazazi Nipendeni. At the time of the quantitative endline, only 18.5% (n=101) of the 545 treatment households that reported ever receiving SMS from Wazazi Nipendeni had also received a message in the month preceding the survey. The remaining 81.5% (n=444) did not receive any Wazazi Nipendeni content in the previous month.

Both the qualitative data and the quantitative data also indicate that mothers from poorer households were slightly less likely to take up Wazazi Nipendeni and continuously use the service compared with less poor households. The qualitative evaluation suggests that less continued engagement among very poor mothers could be because of a lack of access to supportive infrastructure (e.g. access to mobile phones, network connectivity, or electricity) or because these mothers found the Wazazi Nipendeni service less relevant or less useful (e.g. because they lack the resources required to act on Wazazi Nipendeni advice).

Moreover, it needs to be highlighted that one of the selection criteria for inclusion in the quantitative sample was ownership of a mobile phone. Consequently, about 40% of rural households (based on qualitative estimates and statistics from the initial desk review) who could not afford a mobile phone were excluded from the service altogether. The literature corroborates these observations and a recent systematic review suggests that digital exclusion remains a reality in many rural areas of low-income countries, especially for poor households and women (Salemink *et al.*, 2017). The reasons for the persistent exclusion are diverse and include lack of availability and access, limited knowledge and skills on how to use ICTs, and inability to keep up with dynamic digital developments. Of course, Wazazi Nipendeni never had a particular focus on reaching poor or rural families.

5.1.3 Reach of Wazazi Nipendeni in the comparison group

The take-up of Wazazi Nipendeni in the treatment group was considerably higher than in the ‘real world’ (i.e. the comparison group), which is not surprising given the door-to-door offer and assistance in registering for the service provided by the evaluation team. Without the offer, Wazazi Nipendeni was not very effective in reaching mothers – only 26.7% of households in the control group reported having received nutrition-related automated SMS messages during the preceding two years, compared to 66.4% in the treatment group. Only 12.8% of control households reported having received SMS messages from Wazazi Nipendeni.

5.1.4 Households that successfully received Wazazi Nipendeni messages were likely to read them

Treatment households that had received Wazazi Nipendeni messages on their phones were overwhelmingly likely to have read all of the messages (85.8% of ever-receiving females and 86.1% of ever-receiving males). This finding was also echoed by the qualitative data and indicates that SMS-based information services are a good delivery modality in areas with high levels of literacy (such as rural Tanzania). In this context it should also be noted that text messages were sent in Swahili, which unites Tanzania as the national language.

The evaluation has identified several barriers that can help to explain why so many treatment households could not be successfully reached by Wazazi Nipendeni: (a) availability of a supportive infrastructure; (b) behaviours of the target group; and (c) factors related to the implementation and design of Wazazi Nipendeni. Each is discussed in turn below.

5.1.5 Limited reach due to shortcomings in the available supportive infrastructure

The recently published WHO recommendations on digital interventions for health highlight the importance of a reliable supportive infrastructure for the effective reach of digital health interventions, especially in resource-poor settings (WHO, 2019). The current evaluation found evidence of several shortcomings in the supportive infrastructure in Tanzania that reduced the reach of Wazazi Nipendeni.

Women have limited access to and ownership of mobile phones

Based on the quantitative baseline data, only 60% of women in the treatment households owned a mobile phone, compared to 91% of men. Based on the qualitative data, women who did not own a mobile phone but used the mobile phone of a family member to subscribe to Wazazi Nipendeni often had limited control over their access to the phone and the messages. In many cases their phone access was irregular, closely monitored by the phone's owner, and restricted to occasional calls in the case of emergencies. While some mobile phone owners (usually the husbands) regularly shared the Wazazi Nipendeni messages with the mothers, many did not, for various reasons, including being absent (e.g. to work in nearby towns or to spend time at the house of a different wife in the case of polygamous relationships), having mistaken the messages for spam, or simply forgetting. Some husbands also said that they only shared messages that they felt were beneficial or useful for their wife, but that they would not share messages they did not approve of (e.g. messages on family planning or HIV/Aids protection, or messages on foods they could not afford to buy for their children). Gendered barriers to access to mobile phones in many low- and middle-income countries have repeatedly been highlighted in the literature (e.g. Faith, 2018).

Mobile phone ownership increased the chances that mothers could access and engage with Wazazi Nipendeni text messages but it was not a guarantee of sustained access, as some husbands closely monitored – and often restricted – women's access to their own phones. Merged technology approaches that include alternative communication channels (e.g. radio and/or community outreach workers) are likely to be more inclusive in contexts with limited female mobile phone ownership and access.

Given this understanding of household gender dynamics, men are recognised as a key customer segment and were targeted in the Wazazi Nipendeni campaign materials, which focused strongly on the role of couples in bringing up children. Targeting men with the campaigns may have helped to raise their awareness of Wazazi Nipendeni, and might also positively influence husbands' willingness to permit their wife to access a mobile phone to sign up to Wazazi Nipendeni and regularly read the messages. Both the quantitative and the qualitative evaluations found that it was often less effective to enrol men as Wazazi Nipendeni users, as women's access to Wazazi Nipendeni messages was less reliable if husbands received the messages (as they often did not share the message content with their wives).

Limited access to electricity to charge the mobile phone

Access to electricity to charge mobile phones posed a challenge and only 46% of treatment households were able to charge their phones at home. Households without access to electricity usually charged their mobile phones for a fee at the nearest mobile phone kiosk (97% of those households reported having charging facilities less than 30 minutes away from their house). The qualitative data found that in households where both men and women owned a mobile phone, charging the men's phone was a priority. This is corroborated by the quantitative data, which suggest that men spent almost double the charging fee that women spent per month (TZS 1,813 versus TZS 988⁸).

The qualitative data also found that charging the mobile phone at a kiosk (especially a kiosk outside the village) was a logistical challenge for many women. Women often had limited mobility due to farming and household chore commitments, as well as because of social norms that restrict women from travelling outside their village. As a result, mobile phones that ran out of power often

⁸ £0.6 versus £0.33.

remained switched off for several days. This means that Wazazi Nipendeni messages could be missed.

Multi-SIM-card use and lost SIM cards

Where this was financially possible, subscribers owned and used SIM cards from different MNOs in parallel, which allowed them to switch between networks flexibly, and depending on the best network coverage and tariff. Most subscribers owned one-slot mobile phones⁹ and had to manually exchange SIM cards depending on their needs. As the subscription to Wazazi Nipendeni is linked to a specific SIM (i.e. the SIM the subscriber used at the registration stage), subscribers could easily have missed messages if they were using a different SIM card at the time a Wazazi Nipendeni message was sent.

Manually exchanging SIM cards could also have resulted in SIM cards being lost when not in use. Both the qualitative and quantitative data suggest that lost SIM cards were a major reason for households no longer using Wazazi Nipendeni. The quantitative endline found that 15% of treatment households reported no longer engaging with Wazazi Nipendeni because they had lost the SIM card that they had used to subscribe to the service. According to our qualitative interviews, people usually did not attempt to replace a lost SIM card but rather bought a new SIM card with a new telephone number, or even changed to a different MNO as this was usually cheaper.

In sum, tying Wazazi Nipendeni to one specific SIM card and eliminating the possibility of accessing the service using multiple SIM cards may have negatively affected the reach of the service in a context where multi-SIM use and SIM card loss was high.

5.1.6 Behaviour of the target group

Limited reach of Wazazi Nipendeni beyond subscribers as sharing was uncommon

Even households without access to a mobile phone could benefit from Wazazi Nipendeni if subscribers who received the SMS shared the content. GSMA monitoring and evaluation data suggest that sharing was common (personal communication), but the qualitative and quantitative evaluation data could not corroborate this. The qualitative evaluation findings indicate that only limited content sharing took place between spouses and within the household.

The qualitative data suggest that sharing with people outside the household was even less common. One reason for this was that messages related to pregnancy and early childhood were perceived as very private (a 'family issue'), and not to be shared with others. Other reasons for not sharing included perceiving the content as irrelevant, fearing that others would not believe them or perceive them as arrogant, and simply forgetting to share.

Experimenting with approaches to encourage parents to share the content might increase the reach of mobile phone-based interventions (e.g. highlighting the benefits of sharing for the health and well-being of the entire community).

⁹ As opposed to dual-slot phones, which allow farmers to manage and switch between different active SIM cards easily and without missing communications sent through any of the cards.

5.1.7 Barriers to reach related to the design and implementation of Wazazi Nipendeni

The evaluation also identified several barriers to the reach of Wazazi Nipendeni that were related to the design and implementation of the service.

Wazazi Nipendeni messages were never received, or stopped for no obvious reason

Both the qualitative and quantitative data showed that a considerable number of households had never received Wazazi Nipendeni messages, despite still using the same MNO and SIM card as they had used to subscribe to the service. This suggests that there might have been implementation issues at the provider level (e.g. registered subscribers were not successfully registered for the service by Wazazi Nipendeni, MNOs did not send out messages as planned, or telephone numbers had not been recorded correctly), or at the subscriber level (e.g. treatment households might not have recognised a Wazazi Nipendeni message and deleted/ignored it – for example believing it to be a promotional message).

The qualitative midline also found that some treatment households had to wait a long time until they received their first Wazazi Nipendeni message. These households said they were surprised by the message as they had already forgotten that they had signed up for the service. Long delays between signing up and receiving the service can negatively affect uptake – and ultimately the reach – of a service.

There was also a high proportion of treatment households (56% of all ever-receiving treatment households, based on the quantitative endline) that reported that they had engaged with Wazazi Nipendeni for some time but then the services had suddenly discontinued without an obvious reason (i.e. despite them still using the same MNO and SIM card). Both the qualitative and business model evaluations found several potential explanations for the discontinuation of service delivery, including temporary disturbance in the service provided by the MNOs or technical issues when a pregnancy came to term (i.e. message content had to be changed from pregnancy-related messages to messages relevant for early childhood).

The qualitative data also indicate that only a few treatment households were aware that their subscription to Wazazi Nipendeni was linked to a specific SIM and MNO (i.e. the SIM and MNO the subscriber was using at the registration stage). This meant that subscribers who changed the MNO (and got a new number) would have lost access to the Wazazi Nipendeni service. From March 2017 onwards, the Tanzania Communication Regulatory Authority has allowed customers to retain their numbers when switching from one service provider to another, with their contacts and other information intact.¹⁰ The qualitative data collection at endline suggests that some users changed their MNO during the intervention period (usually moving to the new provider Halotel), but kept their telephone number to ensure friends and family could still reach them.

Wazazi Nipendeni messages were often mistaken for spam because of the 15* sender number**

All three qualitative rounds found that mobile spam – meaning unsolicited text messages, especially advertising – is a considerable unwanted disturbance for many mobile phone users in Tanzania. Many treatment households said that they mistook at least some Wazazi Nipendeni

¹⁰ www.theeastafrican.co.ke/business/Tanzania-mobile-number-portability/2560-3822012-ecgyqz/index.html

messages for spam and thus deleted the messages without reading them or after only reading them partially. The main reason for this was the sender details (i.e. a 15*** number rather than a name; several subscribers said that they were generally suspicious about 15*** numbers as many promotional messages are sent using this number).

The government is regarded as a trusted provider of mobile phone-based information in Tanzania (based on all three evaluation components). However, when MoHCDEG took responsibility for a service, messages would usually come with a 'Ministry short code' that was not used in the case of Wazazi Nipendeni. Branding Wazazi Nipendeni clearly (i.e. in the sender name) could have helped to prevent this misconception and increase the reach of the service.

Self-led registration is not as effective as assisted registration

For mothers (and in particular poor and less educated mothers) to access Wazazi Nipendeni they needed to be able to register successfully and the registration process needed to be as easy as possible. The evaluation shows that registration that is assisted by trusted individuals (e.g. health workers or the survey team) is likely to be more effective and inclusive, as shown below.

Onboarding to Wazazi Nipendeni in 'real life'

There were two ways to register for Wazazi Nipendeni: self-registration and assisted registration. To register themselves, users dialled the short code, *15001#, and completed registration over unstructured supplementary service data (USSD) or texted 'Mtoto' (meaning 'baby' in Swahili) to 15001 and completed registration. They were then guided through a small number of profiling questions (category of user and stage of pregnancy / age of child). Assisted registration took place through field partners (there were 24 field partners, including local NGOs), who may have been running specific programmes incorporating the Wazazi Nipendeni platform. Registration data show that 57% of users were registered by partners. Business model analysis pointed out that registration through partners often focused on specific sub-groups of interest for the partner, such as poor, less educated women in rural areas.

A large proportion of the remaining users usually also experienced some degree of assistance when registering (e.g. government health workers guiding users through the registration steps on their own mobile phones). Based on business model analysis it is not possible to determine exactly how many of the 43% of 'other' subscribers actually registered by themselves, but around 60% of them were registered using USSD, suggesting that they were assisted with their registration. This means that up to 83% of users came to Wazazi Nipendeni through assisted registration.

Although mass media channels can be effective in raising awareness of the Wazazi Nipendeni campaign, it is partners and other trusted individuals that are instrumental in converting interested people into users. People may lack a sufficiently detailed understanding of the product to convince them to register for themselves, whereas some personal contact can help get them signed up. The TFNC also believes (based on interviews conducted as part of the business model evaluation) that people who register with a health professional will have a positive bias to comply with the service, have a better understanding of how the service works, and be more likely to appreciate how they can benefit from the service. It is likely to be known and trusted individuals who are most influential in assisting with registrations, e.g. community health workers and community and religious leaders.

With regards to the type of users Wazazi Nipendeni attracts, the registration database provided by the mHealth Tanzania-PPP states that the majority of users (75%) were signed up as pregnant women (usually during the first two trimesters of pregnancy), 10% were signed up as women with a newborn, 12% were general information-seekers, and 3% were supporters of one type or another

(e.g. husbands or mothers-in-law). The qualitative follow-up study provided further insights into the characteristics of long-term users of the service. It found that mothers in their twenties were most likely to engage with Wazazi Nipendeni in the long term, which is not surprising given that this is the peak of fertility for women in Tanzania. Both first-time mothers as well as experienced mothers continued to engage, although the reasons for their engagement varied. First-time mothers sought to receive guidance and reassurance from the messages, whereas experienced mothers wanted to get access to the latest knowledge on childcare and sought information on specific childcare-related problems that they had not experienced with their previous children. Considering the different information needs of first-time and experienced mothers in the messages could help to increase the long-term engagement of different types of mothers, although it might also increase implementation costs.

Onboarding to Wazazi Nipendeni in the evaluation

The quantitative team facilitated the onboarding process for all treatment households at the end of the quantitative baseline survey. Based on qualitative data, many mothers (and fathers) decided to join Wazazi Nipendeni because they enjoyed the face-to-face interactions with the quantitative team, felt honoured to be visited by researchers, and perceived the team to be very credible and professional.

The findings show that face-to-face interaction and assistance is important for successful registration with Wazazi Nipendeni, and can ensure that especially poor and less educated women (who might otherwise not register) are reached.

Lack of interpersonal contact and human support as a barrier to continuous engagement with Wazazi Nipendeni

Wazazi Nipendeni was a one-way mobile phone-based intervention that pushed health and nutrition information to users. The lack of interpersonal contact was perceived as a major limitation of Wazazi Nipendeni by many users. In particular, mothers said that they missed personal rapport, dialogue, and support from human beings. Over time, the lack of interpersonal contact may also have negatively affected mothers' trust in the credibility of the information.

Introducing occasional interpersonal interactions (e.g. outreach by community health workers) or introducing a call centre (or similar) may help to increase reach and sustained engagement. The availability of some kind of real-time human support (e.g. through a call centre) has been shown to increase continued engagement with digital behaviour change interventions (Michie *et al.*, 2017). The literature further suggests that interactive digital interventions in which users are given the opportunity to contact experts for support and advice report higher levels of engagement than one-way interventions (i.e. interventions in which information is only pushed out) (Couper *et al.*, 2010). To increase active and continued engagement with Wazazi Nipendeni the add-on of a human support feature should be considered (although, of course, this would also increase the implementation costs of the service).

5.1.8 Lessons learned and recommendations: how to optimise the reach of Wazazi Nipendeni

Wazazi Nipendeni can only be effective in providing information and changing childcare and nutrition practices when pregnant women and mothers are effectively reached by the service. The evaluation found that the reach of Wazazi Nipendeni was low. The limited reach can be explained by shortcomings in the available supportive infrastructure (i.e. considerable gendered barriers to

access to mobile phones in rural Tanzania, difficult electricity access, and multi-SIM-card behaviour, with frequent loss of SIM cards), very limited sharing of the content of Wazazi Nipendeni, and issues in the implementation (i.e. users never received Wazazi Nipendeni or the service was suddenly discontinued without obvious reason) and the design of Wazazi Nipendeni (i.e. users mistook messages for spam due to unclear sender details, and the lack of human support to encourage continuous engagement). Mobile phone-based services may also generate new inequalities: very poor mothers who could not afford a phone or had limited/no access to a phone were often excluded from the service. This is a finding that is also supported by the literature as it relates to rural areas in other low-income countries (see e.g. Salemink *et al.*, 2017; Kansime *et al.*, 2019). However, it should also be highlighted that both mothers and fathers who successfully received Wazazi Nipendeni messages usually read the majority of the messages. This suggests that the content of the Wazazi Nipendeni messages was not to blame for the low reach.

Based on the evaluation findings, to optimise the reach of Wazazi Nipendeni and/or similar mobile phone-based advisory services, the following recommendations should be considered:

- The availability of supportive infrastructure is an important requirement to enable a mobile phone-based information service to effectively reach the intended target group in a chosen context. This includes sufficient autonomy of the target group over the access to a mobile phone (i.e. access is not controlled and restricted by the owner) or ownership of a mobile phone (especially among women), and easy access to electricity to charge the mobile phone (without long down times due to lack of electricity or lack of money to pay for electricity). If these requirements are not met, or are not met for a large proportion of the intended target group, alternative modes of content delivery (e.g. via radio or community outreach) or blended approaches (e.g. radio and community workers) may have a wider reach and be more inclusive.
- Tying a mobile phone-based service to one specific SIM card in a context in which people frequently manually switch between multiple SIM cards can pose a barrier to the effective reach of a mobile phone-based information service. This is because levels of SIM card loss are often high and messages may be missed because another SIM card is in use. Enabling users to access the service using multiple SIM cards may increase long-term engagement.
- To ensure sustained engagement with a mobile phone-based service such as Wazazi Nipendeni it is important that users are made fully aware of the conditions of their use (e.g. access to the service is linked to one specific SIM and changing this will mean discontinuation of access to the mobile phone-based service). As part of this, users should also be informed about how to re-subscribe to the service if they wish to.
- Text messages can be an effective delivery modality for information in contexts with high levels of literacy and one commonly spoken language (as long as the target group successfully receives the messages and there are no other barriers to reach).
- The sharing of Wazazi Nipendeni content could increase the reach of the service considerably, including to mothers who are currently excluded (e.g. because they cannot afford a mobile phone or do not have access). However, the evaluation suggests that sharing does not frequently happen (not even within the same household). Wazazi Nipendeni could experiment with approaches to actively encourage message sharing (e.g. by sending reminders to share and highlighting the benefits of sharing, such as improving the well-being of the entire community).
- In a context with high levels of unwanted mobile spam, a clearly identifiable sender name (e.g. 'Wazazi Nipendeni') can prevent text messages being mistaken for spam and deleted without being read.

- Interpersonal contact with individuals who are perceived as credible (e.g. health workers) is important to build initial trust in a mobile phone-based service, and can motivate mothers/their households to sign up.
- Adding human support features to mobile phone-based services is likely to increase reach, long-term trust in the credibility of the messages, and sustained engagement. This could include occasional interpersonal contact with promoters/outreach workers and implementation of a well-functioning expert call centre.

5.2 Impacts of Wazazi Nipendeni on nutrition outcomes

This section answers the evaluation question – What are the impacts of Wazazi Nipendeni on nutrition outcomes (including knowledge and behaviours), especially among extremely poor women?

5.2.1 Recap of the primary and secondary outcomes of interest

According to the pathway of impact in the ToC (see Section 2.2), the primary outcomes of interest for the quantitative evaluation of Wazazi Nipendeni are:

1. women's dietary diversity;
2. IYCF; and
3. nutritional status of children.

Secondary outcomes include a large set of variables to measure the take-up and use of Wazazi Nipendeni, as well as improvements in IYCF knowledge and behaviour.

5.2.2 Small impacts of Wazazi Nipendeni on IYCF knowledge and practices and dietary diversity

Given the lower than expected reach of Wazazi Nipendeni, it is not surprising that the impacts of the service on the outcomes of interest were very limited. The quantitative evaluation found that access to Wazazi Nipendeni resulted in a small but statistically significant increase in knowledge among men (treatment group males answered 1.7% more IYCF knowledge questions correctly than control group males) and some small, statistically insignificant improvements in knowledge among women. A combined household-level IYCF knowledge score also statistically significantly increased, with treatment households answering 0.9% more questions correctly on average (see

Table 3).

Based on the qualitative interviews, most mothers and many fathers who read the messages valued Wazazi Nipendeni text messages as a source of credible information. The messages were often perceived as a welcome reminder and reinforcer of existing (but often forgotten) knowledge on childcare and feeding practices (usually received during antenatal visits). While the content of the messages often echoed the information received from health workers, many parents said they found the SMS messages easier to comprehend as they could be read in private rather than being

delivered in an overcrowded and noisy health facility. Many parents also complained that they rarely received advice on IYCF as their health workers were usually too busy to provide such advice and too focused on completing the required health test quickly.

Table 3: Impact of Wazazi Nipendeni on nutrition and health knowledge

	Control mean	ITT estimates	LATE estimates	N
Percentage of correct answers: female	69.0	0.8 (0.651)	1.8 (1.520)	2,469
Percentage of correct answers: male	59.0	1.7** (0.713)	4.3** (1.887)	2,204
Anderson index: combined correct percentages of females and males	-0.05	0.09** (0.042)	0.2** (0.100)	2,114

Notes: ITT estimates measure the impact of the offer of access to Wazazi Nipendeni on outcomes. LATE approximates the impact of receiving Wazazi Nipendeni on outcomes for households that were induced to receive the service by the random door-to-door offer. Estimates are taken from the mNutrition Tanzania endline survey sample. Standard errors are in parentheses and clustered at the village level. Reported are the second-stage estimates from the instrumental variable regression, where an indicator variable of household-level mNutrition use over the last two years is instrumented by the treatment variable, controlling for baseline household classification and value of the respective outcome at baseline. Extended controls are covariates from baseline: household size, whether household head is female, whether household head is literate in Swahili, whether primary female owns a mobile phone, and Poverty Probability Index score. The control mean is the comparison group's mean at endline. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Source: Authors' own, based on Gilligan *et al.* (forthcoming, 2020)

The quantitative data show that access to Wazazi Nipendeni also resulted in a significant increase in dietary diversity for children aged 6–35 months, and also increased the likelihood that these children met the MDD threshold (by 3.8 percentage points) and the minimum acceptable diet threshold (by 6.9 percentage points for children aged 6–23 months) (see Table 4). There was also a small but statistically significant increase in the dietary diversity for women, and an increased likelihood that these women met the MDD for women threshold (by 3.9 percentage points). These improvements in child and female diets were present despite there being no observed changes with regards to the households' overall food consumption patterns.

The LATE impacts are approximately 2.5 times larger than the ITT estimates, owing to the estimated 40% difference in self-reported exposure between treatment and control households. As mentioned earlier, the LATE estimates will be upper bounds on the true impact of receipt of the service if the self-reported exposure gap between treatment and control households is smaller than the true exposure gap. Bearing this caveat in mind, the LATE estimates suggest receipt of the mNutrition service had meaningful impacts on male IYCF knowledge, and on some indicators of child and maternal dietary quality for complier households. Receiving the mNutrition content increased male IYCF knowledge by 4.3%, increased the child dietary diversity score by 0.28 categories, and increased the likelihood of meeting the MDD threshold by 9.7 percentage points for children aged 6–35 months. The likelihood that children aged 6–23 months achieve a minimum adequate diet similarly increased by 21 percentage points.

The qualitative data help to explain the positive findings. Mothers (and some fathers) especially valued the practical, hands-on advice Wazazi Nipendeni messages provided, which they often did

not receive from other sources (e.g. health workers). Particularly valued was advice related to the types of foods young children can consume, and how to prepare them in such a way so that they are suitable for young children (e.g. meat should be minced so that young children can swallow it easily), and practical advice on maternal diets, which can help to explain the positive impact on dietary diversity.

Table 4: Impacts of Wazazi Nipendeni on dietary diversity for children and women

	Control mean	ITT	LATE	N
Children				
Number of food groups (of seven) children aged 6–35 months consume	3.8	0.11*	0.280**	2558
		(0.06)	(0.14)	
Children aged 6–23 months who consume four or more food groups	0.6	0.001	0.015	843
		(0.03)	(0.09)	
Children aged 6–35 months who consume four or more food groups	0.6	0.038*	0.097*	2558
		(0.02)	(0.05)	
Children aged 6–23 months who meet the minimum meal frequency	0.8	0.025	0.083	846
		(0.03)	(0.07)	
Children aged 6–23 months who meet the minimum acceptable diet	0.2	0.069**	0.210**	830
		(0.03)	(0.09)	
Women				
Met MDD for women	0.6	0.039*	0.079	2535
		(0.02)	(0.05)	

Notes: ITT estimates measure the impact of the offer of access to Wazazi Nipendeni on outcomes. LATE approximates the impact of receiving Wazazi Nipendeni on outcomes for households that were induced to receive the service by the random door-to-door offer. Estimates are taken from the mNutrition Tanzania endline survey sample. Standard errors are in parentheses and clustered at the village level. Reported are the second-stage estimates from the instrumental variable regression, where an indicator variable of household-level mNutrition use over the last two years is instrumented by the treatment variable, controlling for baseline household classification and value of the respective outcome at baseline. Extended controls are covariates from baseline: household size, whether household head is female, whether household head is literate in Swahili, whether primary female owns a mobile phone, and Poverty Probability Index score. The control mean is the comparison group's mean at endline. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

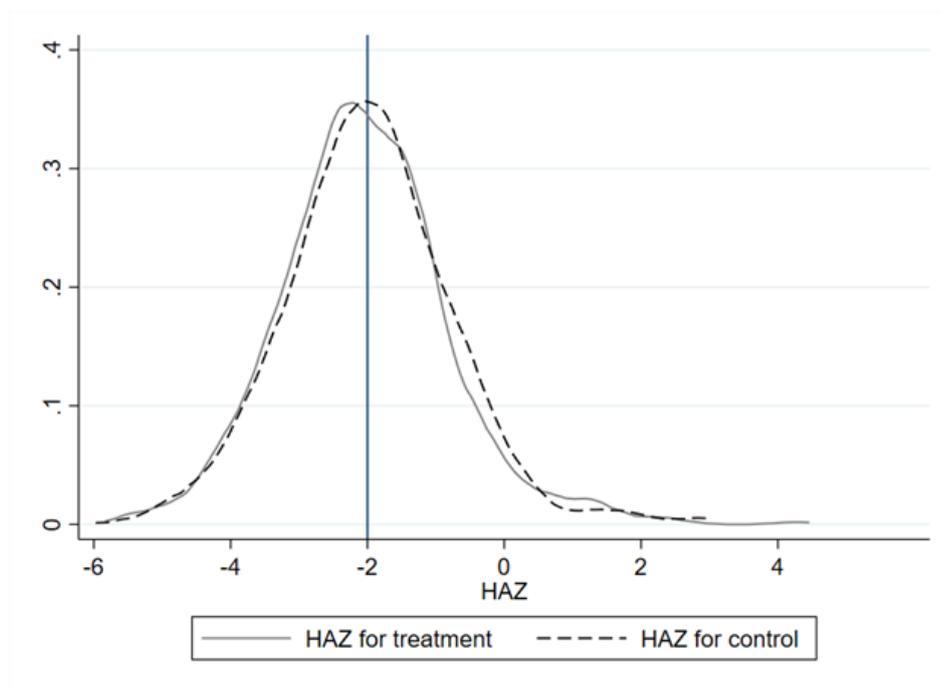
Source: Authors' own, based on Gilligan *et al.* (forthcoming, 2020)

Together, these results suggest that providing access to Wazazi Nipendeni was sufficient to lead to some small improvements in both IYCF knowledge and dietary diversity among children and mothers.

5.2.3 No impact of Wazazi Nipendeni on nutritional status

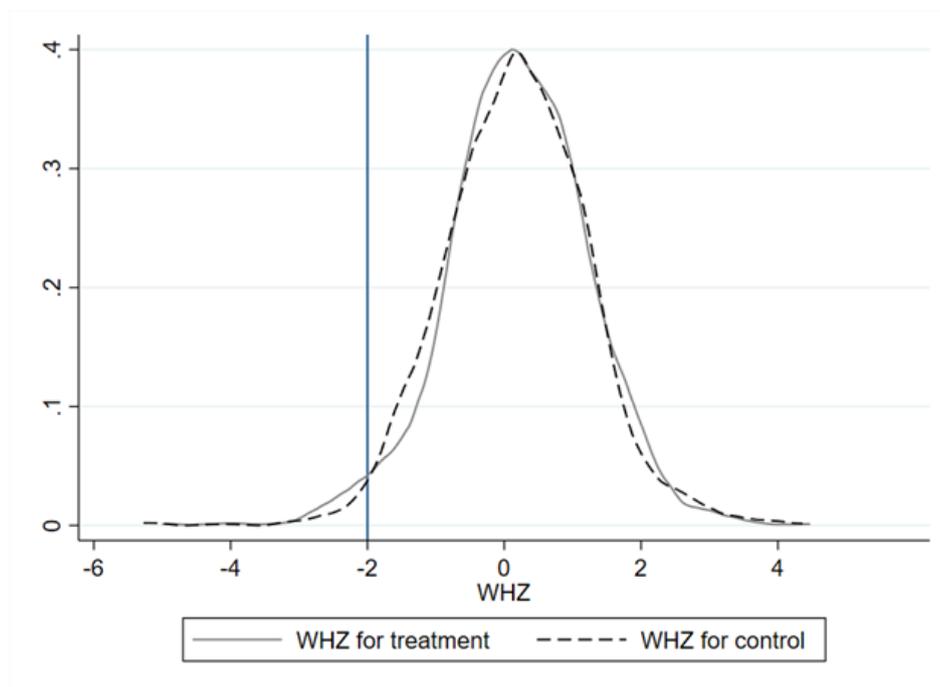
Despite the small positive impact of Wazazi Nipendeni on IYCF knowledge and dietary diversity, the quantitative evaluation found no evidence that access to Wazazi Nipendeni had any impact on children’s nutritional status, as measured by anthropometry (height-for-age z-scores (HAZ), weight-for-height z-scores (WHZ), stunting, and wasting) (see Figure 5).

Figure 5: No impact of Wazazi Nipendeni on children’s HAZ



Notes: X-axis presents the HAZ scores. The blue line presents the -2 Z-scores cut-off for stunting.

Source: Authors’ own, based on Gilligan *et al.* (forthcoming, 2020)

Figure 6: No impact of Wazazi Nipendeni on children's WAZ

Notes: X-axis presents the WAZ scores. The blue line presents the -2 Z-scores cut-off for wasting.

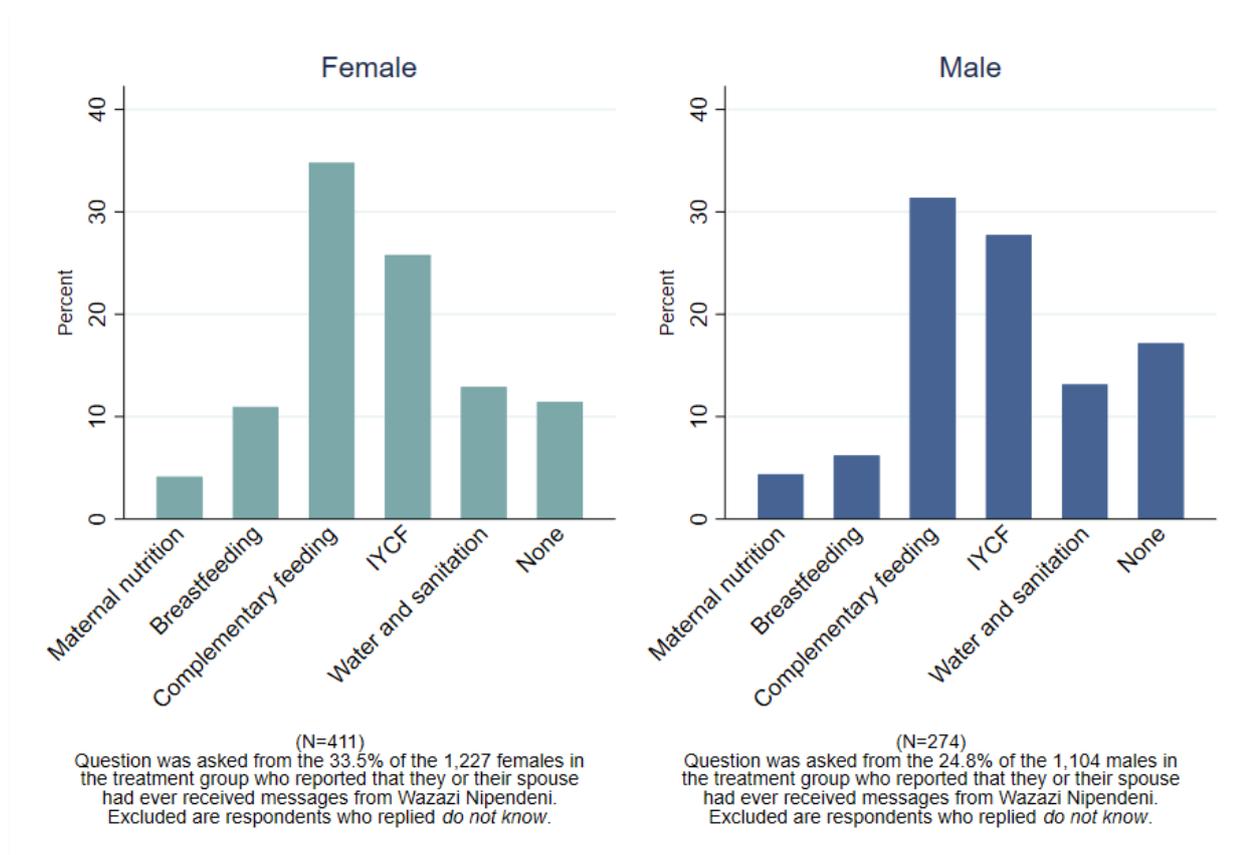
Source: Authors' own, based on Gilligan *et al.* (forthcoming, 2020)

Both the qualitative and the quantitative evaluation found several potential factors that can help to explain why the small increases in dietary diversity and nutrition knowledge might not have translated into an improvement in the nutritional status of children. First, while Wazazi Nipendeni provided information that pregnant women, mothers, and (at least some) fathers perceived as highly relevant and useful, it did not support the generation of an enabling environment that supported families to act and adopt new practices. The qualitative midline and follow-up study identified several contextual barriers that frequently impeded the translation of the advice into practice. The most commonly cited barrier was financial constraints that prevented households from purchasing recommended foods and eating more diverse diets regularly. To increase the impact of Wazazi Nipendeni and enable families to act on the messages, it should be joined up with other ongoing interventions that help poor families to cope with poverty (e.g. social protection programmes, access to financial services, etc.). Second, while Wazazi Nipendeni messages were valued as a relevant and trusted source of knowledge, both the qualitative and quantitative baseline assessments showed that most women already had good general knowledge of IYCF practices, and also had access to at least one credible source of nutrition information (usually government health workers). This suggests that lack of knowledge and access to information were not the main reasons for poor nutritional status among children in Iringa.

5.2.4 Nevertheless, Wazazi Nipendeni triggered a variety of individual-level changes in IYCF practices and nutrition behaviours

Despite the modest measurable impact of Wazazi Nipendeni on the outcomes of interest, the majority of mothers (88.7%) and fathers (81%) who reported ever having received Wazazi Nipendeni messages (n=685) said that they had translated at least one piece of advice into practice. Figure 7 plots the type of advice that parents reported implementing, with those who implemented none of the tips included as a separate category. Advice on complementary feeding and IYCF practices were the most likely to be acted upon, whereas advice on breastfeeding and maternal nutrition were least likely to be put into practice.

Figure 7: Advice from Wazazi Nipendeni that parents put into practice, by gender



Source: Authors' own, based on Gilligan *et al.* (forthcoming, 2020)

The qualitative data corroborate these findings and also suggest different pathways by which Wazazi Nipendeni helped to trigger and promote changes in dietary and child feeding practices among Wazazi Nipendeni users.

Several mothers described how their husbands liked and actively encouraged their wives to read and act upon the Wazazi Nipendeni messages, as they believed the content benefited the well-being of the household.

Some mothers used the Wazazi Nipendeni messages to enhance their bargaining power in intra-household spending negotiations by convincing husbands to purchase more nutritious foods, or to provide mothers with money to do so. For these women, the messages gave their requests more

weight and credibility, as the messages were believed to be based on the objective advice of the government/national experts.

Some mothers perceived the Wazazi Nipendeni messages as a form of constant monitoring of their childcare practices. They believed that the messages guided them in the manner of a 'friendly coach', pointing out sub-optimal practices in a supportive manner (and without reproaching them). To maintain the perception of a friendly and omnipresent coach, a non-judgemental tone and accurate timing of the messages (e.g. stages during pregnancy) are crucial.

Many mothers used advice from Wazazi Nipendeni to develop their own context-specific approaches, adapted to their financial conditions and capabilities (e.g. eating meat as often as financially possible, rather than several times a week as recommended). We should not expect unilineal knowledge transfer through mobile phone-based advice to be translated into changes in practices; rather, what should be encouraged is the flexible use of the information to inform learning.

The qualitative data also indicate that Wazazi Nipendeni messages may have increased the utilisation of healthcare services (there are also some tentative quantitative data to support this finding). Several Wazazi Nipendeni messages actively encouraged mothers to increase their utilisation of such services: eight encouraged parents to bring their child to a clinic for health and nutrition advice and services, six further messages urged mothers to seek services and advice from health workers, and other messages promoted the uptake of community-based child growth monitoring. Furthermore, in the qualitative interviews many mothers said that they visited their health workers more frequently now, as the messages kept on reminding them to do so. Several (mainly first-time) parents also described how the messages helped them to feel more confident when asking for advice or services from their health workers, as the messages had made them aware of their right to receive these.

To sum up, the evaluation findings indicate that Wazazi Nipendeni was able to trigger at least some change in dietary and IYCF behaviours and practices among those mothers (and fathers) who actively engaged with the service. Advice was often adapted and contextualised to the financial conditions and capacity of the households. Focusing more strongly on providing practical advice rather than repeating high-level recommendations can help to strengthen the messages and further increase the chances of impact (e.g. messages on breastfeeding).

5.2.5 Wazazi Nipendeni had a positive impact on mobile phone use

The quantitative evaluation found that offering Wazazi Nipendeni led to a significant increase in mobile phone use (by 5.3 percentage points). We found meaningful impacts on the likelihood of sending and receiving text messages (by 5.8 and 5.9 percentage points for females, respectively), and on making or receiving phone calls (by 4.8 and 3.6 percentage points for females, respectively), and an increased likelihood of receiving mobile money (by 4.1 percentage points), as well as an increased likelihood of sending mobile money (for males only) (see

Table 5 for the data on females only).

Consistent with the increased use of mobile phones, treatment households also reported spending more on mobile phone airtime vouchers. The impact estimates indicate that the offer of access to the service increased mobile phone spending by just under 10% during the month preceding the endline survey.

Table 5: Positive impact of Wazazi Nipendeni on mobile phone use among females

	Control mean	Impact estimates	N
Used mobile phone in the last 14 days to make calls	0.625	0.048** (0.020)	2,469
Used mobile phone in the last 14 days to receive calls	0.701	0.036* (0.020)	2,469
Used mobile phone in the last 14 days to write text messages	0.457	0.059*** (0.019)	2,469
Used mobile phone in the last 14 days to receive text messages	0.564	0.058*** (0.020)	2,469
Used mobile phone in the last 14 days to receive mobile money	0.170	0.041*** (0.016)	2,469
Mobile phone used on most days over the last 14 days	0.448	0.053** (0.021)	2,064

Notes: Estimates from the mNutrition Tanzania endline survey sample. Standard errors are in parentheses and clustered at the village level. Impact estimates report the coefficient on the treatment from an ordinary least squares regression of the outcome of interest on the treatment variable, controlling for baseline household classification and value of the respective outcome at baseline. For variables that were not collected at baseline, the model controls for phone ownership at baseline. Extended controls are covariates from baseline: household size, whether household head is female, whether household head is literate in Swahili, whether primary female owns a mobile phone, and Poverty Probability Index score. The control mean is the comparison group's mean at endline. Estimates for outcomes that were not observed at baseline are based on simple differences. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Source: Authors' own, based on Gilligan *et al.* (forthcoming, 2020)

The qualitative data further elaborate these findings and also suggest that Wazazi Nipendeni increased loyalty towards the MNO and SIM card that users had used to subscribe to the service. These women often said that they were now allowed to access their husbands' mobile phones more freely (to read the Wazazi Nipendeni messages, but also to send text messages and make calls).

5.2.6 Lessons learned and recommendations: impacts of Wazazi Nipendeni

Access to Wazazi Nipendeni had small positive impacts on IYCF knowledge among men and women (statistically significant only among men), as well as on dietary diversity among children and women. However, these positive impacts did not translate into an improvement in nutritional status among children. The limited impact of Wazazi Nipendeni can in part be explained by the low reach and very limited sustained engagement with the service, and contextual barriers that prevented families from translating Wazazi Nipendeni advice into practices (most importantly, the lack of financial resources).

- To increase the impact of a mobile phone-based service such as Wazazi Nipendeni and to enable poor families to act on the messages, it should be joined up with other ongoing interventions that help poor families to deal with poverty (e.g. social protection programmes).

Despite these disappointing overall impact findings, both our quantitative and qualitative data suggest that mothers/fathers who actively engaged with Wazazi Nipendeni made at least some

changes in their IYCF and caring practices, as well as to the foods they ate themselves and served to their families. The types of changes made varied greatly and depended on the financial circumstances, capacities, and contexts of the households.

- To capture the multitude of granular effects Wazazi Nipendeni had on households' behaviours and practices, while also considering the varying lengths and intensities of engagement with the service and the dynamics of the service, future evaluations should consider complementing rigorous experimental designs with more agile, short-term, and adaptive evaluation methods (e.g. rapid randomised controlled trials or real-time randomised controlled trials (Pasanen and Barnett, 2019)).¹¹ Such methods are also well suited to inform the ongoing development and adaptations of a mobile phone-based intervention alongside its implementation (Mohr *et al.*, 2015).¹²

The evaluation findings also suggest that offering Wazazi Nipendeni positively influenced females' and males' use of mobile phones. In particular, women – who often only had limited and closely monitored access to mobile phones in Iringa Region – were significantly more likely to have used mobile phones. This suggests that services such as Wazazi Nipendeni might help to bridge the digital gender gap by convincing husbands of the benefits of allowing their wives to access mobile phones more freely (to read Wazazi Nipendeni messages that, if acted upon, could benefit the well-being of the family).

5.3 Process of content development for Wazazi Nipendeni

This section answers the evaluation question – Has the process of adapting globally agreed messages to local contexts led to content that is relevant to the needs of poor mothers and pregnant women and their families?

5.3.1 Recap of the content development process for Wazazi Nipendeni

The 300 nutrition messages included in the Wazazi Nipendeni text message service were drawn from 42 factsheets on nutrition-related behaviours that were developed by the global content provider for mNutrition, GAIN. The information contained in these factsheets was adapted to the context of Tanzania and made mobile-ready by Every1mobile and the Centre for Counselling, Nutrition and Health Care, a Tanzanian NGO working in nutrition, under the guidance of MoHCDGEC and TFNC.

As part of the adaptation process the message content was tested with potential users in Tanzania, after which the language and substance were adjusted. The message testing process highlighted the importance of replacing technical terminology that was likely to be unfamiliar to the message recipients with language that was more commonly used but that still conveyed the evidence-based content of the original factsheets.

¹¹ This recommendation is also in line with advice an international panel of experts recently issued with regard to the evaluation of digital behaviour change interventions (Michie *et al.*, 2017).

¹² It should be highlighted that the evaluation approach that was used also informed the ongoing development and implementation of Wazazi Nipendeni.

5.3.2 High levels of overall acceptance of the Wazazi Nipendeni content

The qualitative midline involved an in-depth assessment of the acceptance of Wazazi Nipendeni among mothers and fathers based on the technology acceptance model (Davis, 1993). The assessment included perceived usefulness, perceived ease of use, trust, and social influences on use related to both the content of Wazazi Nipendeni and the mode of delivery. Overall, the Wazazi Nipendeni content received positive feedback from most users on all levels.

The qualitative evaluation found that mothers/fathers who received the service valued Wazazi Nipendeni messages as a personalised guide through the various stages of pregnancy and early childhood, as a reminder of existing knowledge, and as providing new information. Users of Wazazi Nipendeni messages found most of the messages easy to comprehend and also appreciated their non-judgemental tone. Most messages provided information without blaming or judging mothers (and fathers). Mothers valued this as it was often different from their experiences with health workers, who frequently attributed poor child nutrition outcomes (i.e. undernutrition) to maternal fault (e.g. during community-based growth monitoring) and sometimes blamed mothers publicly.

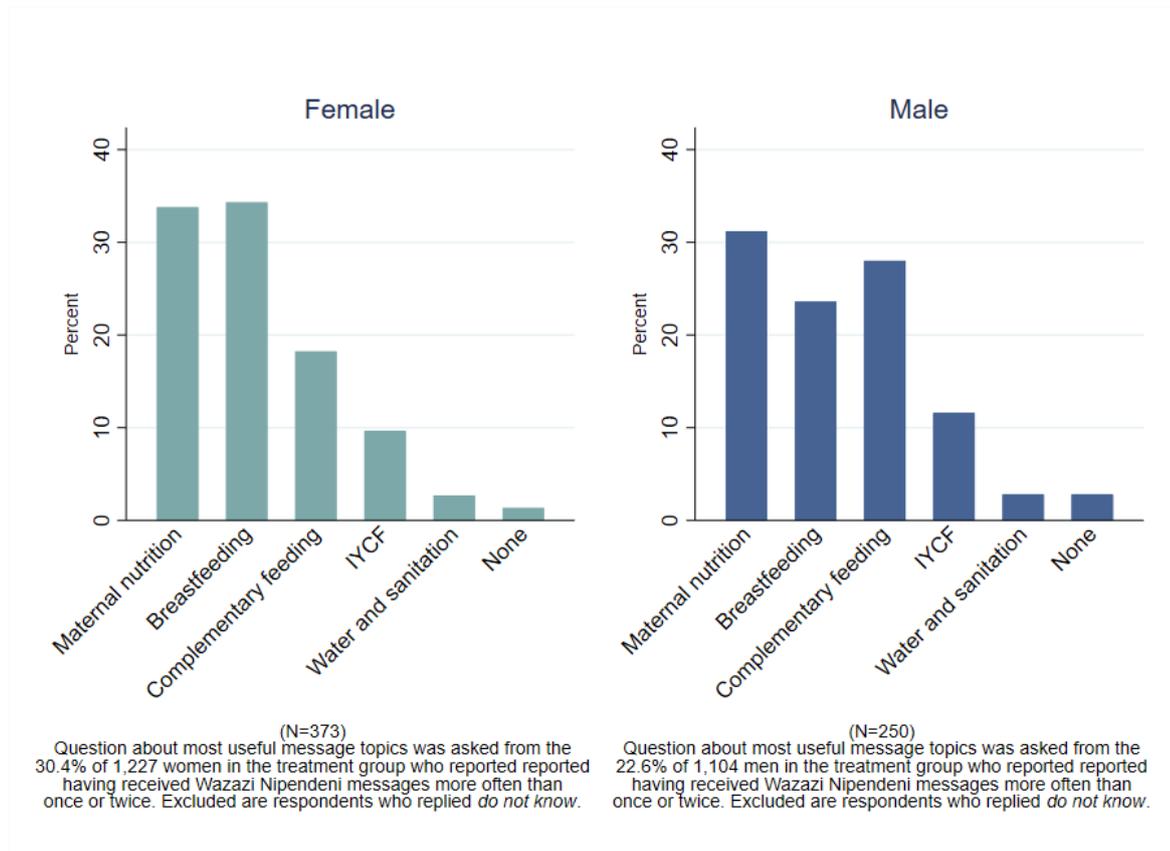
The qualitative data also indicated that Wazazi Nipendeni messages were perceived as particularly useful for mothers for whom access to formal health and nutrition advice was difficult. For example, first-time young mothers (including unmarried adolescent mothers) often lacked confidence to use health services and were excluded from formal services, while mothers who worked outside of their home did not have time to attend health clinics during working hours. Severe staff shortages and overcrowded health facilities meant that health workers were usually under enormous time pressure to complete all required health checks (e.g. based on the antenatal care protocol or the guidelines for growth monitoring). This often left them with little or no time to discuss childcare-related issues with mothers and to provide more specific, practical advice and support. In such contexts, Wazazi Nipendeni messages were often perceived as particularly useful and relevant.

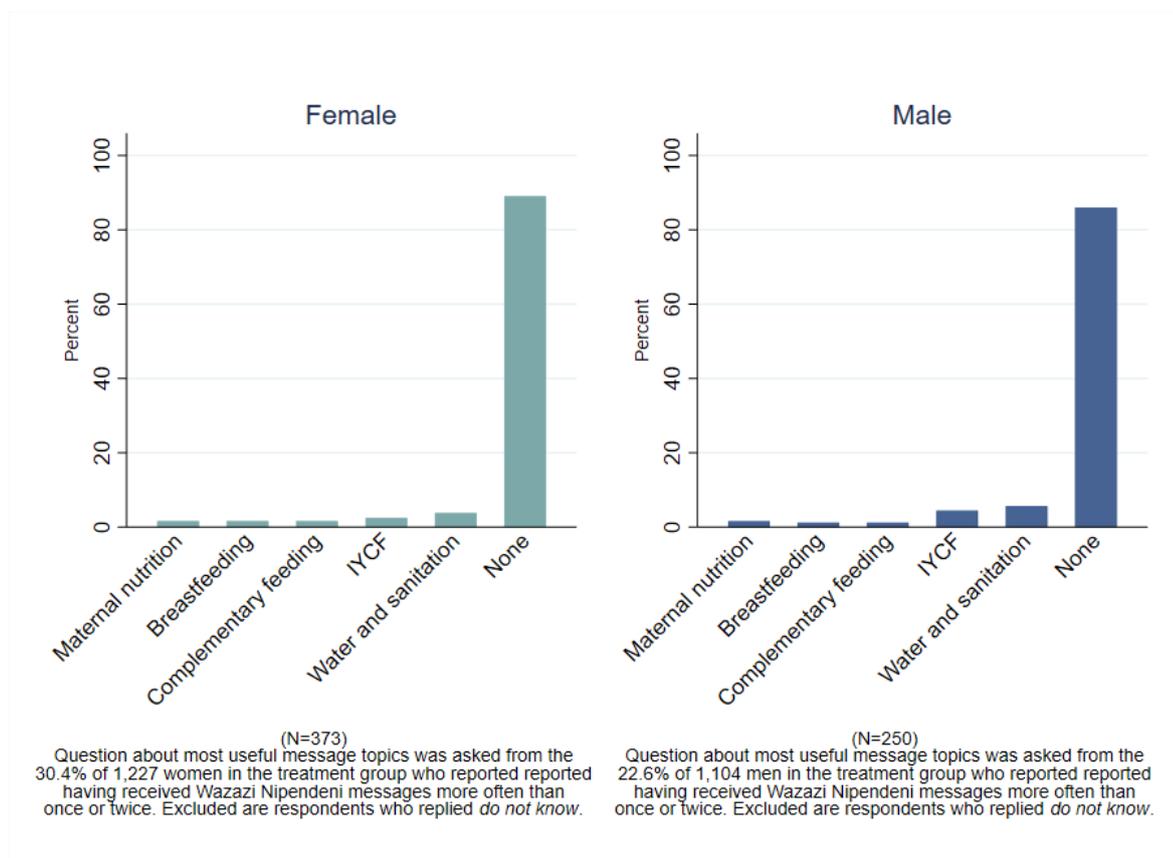
Based on the quantitative endline, perceptions of the content in the Wazazi Nipendeni messages were nearly universally positive: 91% of females and 93% of males who reported having received at least one Wazazi Nipendeni message (n=623) found the messages either always useful or very often useful; similarly, 94% of females and 92% of males reported being likely or highly likely to recommend the service. While the qualitative findings mirrored the quantitative findings for female users of Wazazi Nipendeni, they found that perceptions of usefulness of the messages were mixed among fathers. Many fathers saw themselves as the household head responsible for children's health and nutritional well-being. As part of this role they perceived the messages as very relevant and engaged with the message content themselves and also instructed their wives to do so. However, other fathers felt that nutrition and child health were their wives' responsibility and they therefore did not find Wazazi Nipendeni messages useful and often deleted the messages without reading them. Some fathers also said that they did not need new information on child nutrition and care as they were experienced enough from raising previous children.

In the quantitative endline survey, users who had received Wazazi Nipendeni messages more than once (n=623) were asked to identify the most and least useful functions of the service, and then to rate the quality of different aspects of the service (see Figure 8). Interestingly, the self-reported ordering of message topic usefulness was similar across genders. Females found 'Breastfeeding' (34%) to be the most useful, followed by 'Maternal nutrition' (34%), 'Complementary feeding' (18.2%), 'Other IYCF practices' (e.g. responsive feeding practices, food hygiene) (10%), and 'Water and sanitation' (3%). Males found 'Maternal nutrition' to be the most useful topic (31%), followed by 'Complementary feeding' (28%), 'Breastfeeding' (24%), 'Other IYCF' (12%), and 'Water

and sanitation’ (3%). Both females and males were reluctant to identify any message topic as not being useful, with 89% of females and 86% of males suggesting that none of the topics was the least useful.

Figure 8: Most and least useful aspect of Wazazi Nipendeni, by gender





Source: Authors' own, based on Gilligan *et al.* (forthcoming, 2020)

Both the qualitative and quantitative data also found that Wazazi Nipendeni users trusted the credibility of the content of the messages. Users had high levels of trust mainly because the information was well timed and tailored, because they had heard the majority of the information from other trusted sources previously (mainly during antenatal care visits), and because of the face-to-face registration process, which helped to build initial trust in the service.

Nonetheless, despite the overall positive perceptions about the content of Wazazi Nipendeni, the evaluation findings indicated that not all messages were perceived as equally relevant for the needs of poor mothers, pregnant women, and their families. This is described in the following sections. It should also be pointed out that we were only able to assess the perceptions of those that had received and used the service, and therefore we do not know the perceptions of the majority of mothers and fathers that did not use the service.

5.3.3 Messages that merely reiterated high-level recommendations without practical, contextualised advice were less useful

Based on the qualitative data, and also on an analysis of the Wazazi Nipendeni messages by the evaluation team, there were a large number of messages that merely reiterated high-level recommendations, without providing any practical advice or specific details on how mothers could implement these recommendations. Repeating knowledge is not automatically a bad thing as behaviour change theory indicates that receiving the same knowledge from different sources and through different channels might be effective in triggering change (Briscoe and Aboud, 2012). However, if messages focus mainly on reinforcing existing knowledge, parents might not feel sufficiently enticed to sign up and continuously engage with the service. To ensure ongoing interest

and engagement of mothers with Wazazi Nipendeni, the provision of practical advice and information that addresses mothers' specific information needs is important.

Also important is that practical advice is context-specific (e.g. based on foods that are locally available or on parents' economic capacities), otherwise advice can easily lead to frustration as parents cannot act on it (e.g. advice on feeding children soya, which was not available in Iringa).

The business model analysis provided further insights into the complexity of developing context-relevant, practical messages for Wazazi Nipendeni. Content developers had to find a balance between advocating for best nutritional practices that were in line with government recommendations and delivered following the WHO timing guidelines, while also providing content that was adapted to the local context and actionable by resource-poor mothers (and fathers). Perhaps as a result of this balancing act, the evaluation team's assessment of the messages concluded that many of the messages lacked local contextualisation and remained either quite 'scientific' or overly simplified (rather than actionable and contextualised). It is necessary to ensure the contextualisation of messages to increase the likelihood that information is translated into action.

Message content also needs to be regularly updated to keep it relevant (e.g. when new guidelines are launched based on new scientific evidence). Furthermore, users quickly lose trust in information that is not immediately useful or, even worse, that is wrong. Quality assurance processes for any revisions ought to be as rigorous as those adhered to during the initial content development. The business evaluation could not find any evidence that any of the partners has the mandate or the funding to undertake any ongoing revisions and maintenance.

5.3.4 Tailored messages help to build trust, but can also raise suspicions as pregnancy and childcare are perceived as private family issues

The qualitative data found that Wazazi Nipendeni users highly valued tips that were tailored towards each stage of pregnancy/early childhood. Tailored information was much needed (especially by first-time parents) and was perceived as more relevant compared with the general information parents received during antenatal classes in their village. Accurate tailoring also helped to build trust in the relevance of the service (which was important as there was no human interaction to facilitate trust-building and maintenance).

While the timing was perceived as important for building trust, it also frequently raised suspicions and even fears among users, who could not explain how the message sender could be aware of and familiar with very personal aspects of their lives (i.e. stage of pregnancy or age of their child).

Furthermore, badly timed messages (e.g. due to temporary problems with the system) could negatively affect users' belief in the credibility of the messages overall, and could quickly result in disengagement (especially as there were no human interactions that could reinforce/rebuild trust in the service). These findings highlight the importance of ensuring well-tailored messages at all times. It is also important to carefully explain to new subscribers that they will be receiving tailored messages, and where the messages will come from. Automatic sign-up of mothers (e.g. during their first antenatal visit) is unlikely to be very effective if it is not combined with detailed explanations of the service (preferably by trusted individuals such as health workers).

5.3.5 Messages provided relevant IYCF information, but often did not help parents to address specific and pressing needs

While users generally appreciated Wazazi Nipendeni, they often complained that the content was too generic to help them to address their specific, acute nutritional or health problems (e.g. low weight of children as detected during growth monitoring check-up, low breast milk supply, cracked nipples, child with diarrhoea, etc.). While many Wazazi Nipendeni users stored messages for future reference, they often lacked access to information that would help them to address their specific challenges at the time when they needed the advice, thus limiting the perceived relevance of the content. A potential solution would be to also offer pull services (i.e. services where parents can actively search for information) as part of Wazazi Nipendeni.

That said, the disadvantage of pull services is that they are passive and users can easily get out of the habit of searching for information (especially if the search process is time-consuming because of a weak network signal).

5.3.6 Wazazi Nipendeni messages did not sufficiently acknowledge the different information needs of first-time mothers and experienced mothers

According to the qualitative data, the information needs of first-time parents and experienced parents with previous children often varied. First-time parents often felt ill-prepared to care for their first child and looked for reliable guidance on all areas related to pregnancy, birth, child feeding, and caring practice. In contrast, parents who already had one or more children usually felt more confident in caring for a young child and often looked for information on child health and feeding issues that they were currently experiencing with their youngest child but had not previously experienced with their other children (e.g. skin rashes or food aversions). Basic information on childcare and feeding was frequently perceived as less relevant by these experienced parents.

To ensure that the content of Wazazi Nipendeni messages is relevant, consideration should be given to designing different sets of messages to address each group's specific needs (e.g. including practical nutrition advice for parents who are dealing with several children below five years of age).

5.3.7 Wazazi Nipendeni users adapted and contextualised content further to meet their individual needs and capacities

It is well established that information (knowledge) alone is not necessarily enough to change behaviour (Levin, 2013). There are complex relationships between mediators (e.g. knowledge, attitudes, and beliefs) and actual behaviour: mothers may gain the knowledge, confidence, and intention to change feeding practices, but this will not impact on their actual practices unless their environment enables them to act.

Financial constraints emerged as a major obstacle to the translation of Wazazi Nipendeni advice into practices. For example, many messages recommended that parents purchase animal-sourced foods, such as eggs, meat, and milk, and fresh fruit to use as complementary food or for women to consume regularly during their pregnancy and lactation. However, many poor households directly dismissed these messages as they were outside of their financial capacity, while others tried to adapt the advice to work within their financial conditions (e.g. consuming eggs whenever possible, rather than several times a week; feeding children three meals a day instead of the recommended

five meals). Such adaptations might have still resulted in some benefits for the health and well-being of children and mothers; however, these benefits are unlikely to translate into measurable improvements in nutritional status.

5.3.8 Messages provide information and develop understanding of child nutrition but they cannot develop the skills to put new knowledge into practice (as training would do)

Some mothers said they were eager to follow the advice provided in the Wazazi Nipendeni messages but that they were unsure what exactly they had to do. This challenge was mentioned frequently with regards to messages that promoted breastfeeding. Both the qualitative and quantitative data showed that mothers valued breastfeeding advice (34% of females and 24% of males perceived information on breastfeeding as most useful) but far fewer acted on this advice (11% of females and 6% of males). This can be explained by the fact that breastfeeding practices (and here in particular early initiation of breastfeeding and continued breastfeeding for children aged 12–15 months) were already relatively good at baseline and so was the level of knowledge about breastfeeding. The qualitative midline suggests several explanations for the high ranking of the perceived usefulness of breastfeeding advice in the quantitative survey. These include that mothers felt the messages re-enforced and reminded them of breastfeeding advice they had received during antenatal sessions, and that frequent messages on breastfeeding, especially during the early weeks after birth, were perceived as comforting by exhausted mothers. The majority of Wazazi Nipendeni messages on breastfeeding were generic and simply conveyed high-level recommendations. For example:

The fact is that children who are breastfeeding for the first 6 months are less likely to fall sick. Mother's milk protects them from diseases. (NUT 16)

Dear mother, remember to breastfeed your baby during the day and night. This helps to have more breast milk for the first six months. (NUT 75)

Dear mother, keep breastfeeding your baby regularly until it's 2 years old. Your baby still gets plenty of nutrients from your milk. (NUT 43)

The qualitative data indicated that mothers (and many fathers) usually already knew this information (as it had been provided during their antenatal visits). However, what was often lacking was more specific, practical advice on milk supply management, positioning of the baby, nipple care, and continuation of breastfeeding when the mother is sick. To be more relevant and actionable, Wazazi Nipendeni needs to address these specific information gaps.

However, there are naturally some limits to this. First, some information simply cannot be conveyed by text message (e.g. the optimal positioning of a baby during breastfeeding). Second, other advice might simply be unfeasible to follow because of contextual factors, such as a mother's need to work while a baby is still being breastfed.

Furthermore, breastfeeding is considered a learned skill and can be stressful to establish and maintain. While text message-based programmes have been shown to increase breastfeeding rates in the long term, in the early initiation phase more support is often needed (Gallegos *et al.*, 2014). The qualitative data also suggest that mothers' work obligations outside the home (e.g. on farms or tea plantations) were a huge contextual barrier to acting on breastfeeding advice, and in particular advice to practise exclusive breastfeeding. Given that most women have to work outside their home (either in paid employment or in unpaid work on the family farm), practical advice on

how to combine breastfeeding with work commitments should be included in Wazazi Nipendeni messages (e.g. advice on how to express and store breastmilk so that it can be fed to a child by a caregiver when their mother is unavailable).

In sum, Wazazi Nipendeni messages could be strengthened if they actively encouraged users to seek out health workers for support in the development of necessary skills (e.g. breastfeeding practices).

5.3.9 Lessons learned and recommendations: content development for Wazazi Nipendeni

The evaluation found high levels of overall acceptance of the content of Wazazi Nipendeni for the subsample of mothers/fathers that used the service. Overall, users perceived message content to be easy to understand, useful, and relevant. They appreciated the non-judgemental tone of the messages and the fact that the content was tailored towards the specific stage of their pregnancy or age of the child. Messages were especially valued in contexts in which access to formal health and nutrition advice was limited (e.g. in contexts with overcrowded health facilities in which health workers had little time to provide advice) and by individuals who were excluded from formal services (e.g. due to work commitments or to being unmarried). While the quantitative data suggest that both male and female users of Wazazi Nipendeni perceived the messages as relevant and useful, the qualitative data indicate that fathers' perceptions of the usefulness of the messages were mixed, with some men perceiving the messages as highly useful and others as not useful. Trust in the credibility of the content of the service was generally high. Nevertheless, not all content was perceived as equally relevant and the evaluation also suggests some potential areas for improvements:

- Most Wazazi Nipendeni users were interested in and receptive to practical, context-specific advice that complemented theoretical high-level advice that they had received from other sources (mainly government health workers).
- Intensive and interpersonal support is necessary to influence practices such as breastfeeding and should be offered to complement mobile phone-based services (e.g. by encouraging users to seek interpersonal support from local services). Mobile phone-based services alone cannot help households to develop the skills required to put the information into practice.
- The informational needs of mothers and their families change dynamically and they frequently look for information that would help them to tackle individual, acute nutritional and health problems. Introducing two-way communication channels (e.g. a call centre or interactive dialogues) could enable mothers to actively seek the information they need at the time they need it.
- The content of the Wazazi Nipendeni messages needs to be updated regularly to remain relevant, reliable, and useful. Funding, as well as responsibilities, for regular content reviews and updates of the messages needs to be planned for from the beginning to maintain a relevant service throughout.
- Careful and individualised profiling during the initial registration process, and detailed explanation of the service (preferably by trusted individuals, such as health workers), is vital to build trust and to ensure continued engagement.

5.4 Mobile phone-based services for behaviour change

This section answers the evaluation question – What factors make the mobile phone-based Wazazi Nipendeni service effective in promoting and achieving behaviour change (if observed), leading to improved nutrition outcomes?

5.4.1 Recap of FCDO/GSMA's rationale for a mobile phone-based service changing behaviours

The mNutrition initiative aimed to harness the power of mobile phone-based technologies to improve access to information and change behaviours related to nutrition and health.

mNutrition has two major outcomes. One outcome is the development of cost-effective, sustainable business models for mobile phone-enabled nutrition services that can be replicated across many countries. The second outcome expects these services to result in new knowledge, behaviour change, and adoption of new practices in the area of nutrition among the users of these mobile phone-based services.¹³

Based on the quantitative endline, mothers who had access to Wazazi Nipendeni were significantly more likely (10.4%) to report that automatic text messages were one of two primary sources for nutrition information, compared to mothers who did not have access to Wazazi Nipendeni. Women who had access were also significantly less likely to mention TV/radio/posters as a primary source of nutrition information, compared to their counterparts without access to Wazazi Nipendeni. This suggests that mobile phone-based nutrition information was valued as a delivery channel for nutrition information and that Wazazi Nipendeni induced women to substitute away from information received on TV/radio/posters and towards the information contained in the mobile phone-based Wazazi Nipendeni service.

In the following sections, we will present the evaluation findings on features that gave mobile phone-based channels an advantage over other traditional channels for behaviour change information. Also discussed will be perceived shortcomings of mobile phone-based behaviour change interventions. To better understand how the mobile phone-based Wazazi Nipendeni service was able to trigger (at least some) changes in behaviour, we will also discuss common pathways of behaviour change and key barriers to change that emerged.

5.4.2 Mobile phone-based services such as Wazazi Nipendeni are based on a network of partnerships

The business modelling analysis showed that Wazazi Nipendeni is unique in the complexity of its underlying partnerships. Partnerships have been crucial to accessing all the resources needed to make the service successful and sustainable: content development was led by TFNC; Rasello provide the platform, which is commissioned and paid for by the MoHCDGEC (with CDC funding); four MNOs in Tanzania donate SMS messages free of charge; field partners and government health workers assist users with registration; and government agencies support and facilitate the

¹³ Description based on the terms of reference for this evaluation.

service. For a detailed discussion of the complexity and importance of partnerships for Wazazi Nipendeni please see Section 5.5.4.

5.4.3 Advantages of mobile phone-based services compared to other communication channels for behaviour change

Wazazi Nipendeni provided tailored and time-sensitive information that mothers did not receive from other sources

Mobile phone-based messages can be more targeted to address personal and time-sensitive information needs. Many Wazazi Nipendeni service users appreciated the fact that messages were tailored specifically to their stage of pregnancy or the age of their child. This was perceived as a huge advantage over less well-targeted, more generic information delivered via radio programmes, television, or community-based nutrition events.

Mobile phone-based text messages are more private and cannot be overheard

Many Wazazi Nipendeni users praised mobile phone-based messages for being a private approach to conveying sensitive information on health and nutrition issues. In particular, topics related to pregnancy and young children were often perceived as ‘family concerns’, not to be discussed in public. Concerns about preserving a family’s privacy were also mentioned repeatedly as a reason why voice-based messages were less attractive (as they could easily be overheard).

Young first-time mothers in particular valued the privacy of text messages as they often lacked the confidence to ask for information when visiting health workers. Maternal and child health services in rural Tanzania are often overcrowded due to staff shortages and this also often means there is no space for private conversations between mothers and health workers, meaning conversations can easily be overheard. Moreover, noise levels are usually high (especially as many babies and young children are present). Many mothers therefore said that they found it difficult to hear and concentrate on the advice given by health workers, and that mobile phone-based messages that could be read in a private and calm environment were thus easier to comprehend.

Insecurity and fear of being perceived as naïve also prevented (especially very young) mothers from approaching other more experienced mothers for advice. Wazazi Nipendeni messages were a welcome source of information that did not require parents to engage with others.

Mobile phone-based information services can be used flexibly whenever and wherever there is a demand for information

In contrast to ‘traditional’ behaviour change communication channels (e.g. via health workers), Wazazi Nipendeni users had the flexibility to access the text messages when and where they wanted to (and not only during the opening hours of the health facility or during community-based growth monitoring sessions). Many Wazazi Nipendeni users also liked to save and re-read the messages, although re-reading SMS messages could be difficult or even impossible if the mothers did not own a mobile phone.

Mothers/fathers often engaged more with Wazazi Nipendeni texts when they faced an acute nutritional problem (e.g. their child was refusing to eat or was ill). Parents actively sought solutions for their specific problem during these times and Wazazi Nipendeni messages sometimes provided such help. However, a call centre or an interactive mobile phone-based service might further help to address parents’ specific and time-sensitive information needs.

Frequent mobile phone-based messages help to satisfy mothers' need for continuous reassurance

In a context with limited feedback and advice from health workers (e.g. because mothers only infrequently see health workers and health workers are usually under extreme time pressure, with no time to discuss issues with mothers), mobile phone-based messages can help to satisfy mothers' need for continuous reassurance and feedback. It is well established in the literature that women become frequent information-seekers during pregnancy and the first few years following delivery (Bernhardt and Felter, 2004). Occasional clinic visits and monthly growth monitoring sessions often do not satisfy mothers' ongoing need for reliable information, especially as mothers do not always receive information during these meetings. Several mothers said that the health workers in their clinic would only discuss matters and provide tailored advice when they had detected an acute problem with the nutritional status or health of their children. If there was no problem, they would not get advice. Mothers regretted this and desired more frequent feedback and advice (as delivered with the Wazazi Nipendeni messages).

It should be highlighted that both the quantitative and qualitative evaluation found a huge variety in the frequency with which Wazazi Nipendeni users received messages: 38.3% of women and 46.1% of men in the treatment group reported receiving Wazazi Nipendeni messages less than once per month, while 33.9% of women and 28.0% of men reported receiving messages at least once per week. This variety in frequency might be explained by the stage of pregnancy/age of the child (as the frequency of messages varied accordingly), or by the fact that users simply missed messages. However, it could also be related to the implementation of the service (e.g. the business model evaluation found that the frequency with which messages were sent out might vary depending on the MNO).

5.4.4 Shortcomings of mobile phone-based services compared with other communication channels for promoting behaviour change

Lack of interpersonal contact and human support

While purely information-based Wazazi Nipendeni messages were perceived as useful, mothers/fathers did not experience any peer, social, or emotional support when attempting to adopt the advice that Wazazi Nipendeni provided. Interpersonal contact was also perceived as important to get clarification or ask questions. Including a face-to-face component in the delivery of Wazazi Nipendeni is likely to increase uptake and long-term engagement with the service (especially if face-to-face contact is provided by trusted individuals, such as community health workers). Other examples could include local Wazazi Nipendeni groups or regular Wazazi Nipendeni community events.

The business evaluation found that drop-out rates among Wazazi Nipendeni users signed up by field partners were much lower than among people who self-registered (only 0.3% of API¹⁴ registrations, compared with 42% of short code registrations). This suggests that women who were registered through field partners (who were present and actively interacted with the women) were likely to have a stronger commitment to the service and to stay on the service for longer, were more likely to read the messages, and might also be more likely to adopt improved behaviours.

¹⁴ Application program interface.

Mobile phone-based information services thus work best when implemented in partnership with field agencies with a local presence, which can provide a face-to-face experience for users.

5.4.5 Key barrier to the translation of Wazazi Nipendeni advice into action: poverty

Financial constraints were the most commonly cited factor that prevented mothers from adopting new practices suggested by Wazazi Nipendeni. Qualitative data found that mothers/fathers often had to carefully consider how to best allocate their limited resources between food purchases, healthcare, school expenses, and agricultural inputs or other productive assets. Spending more money on specific food (e.g. animal-sourced foods) for one household member (and here the youngest and least productive member) was not seen as a good investment.

Wazazi Nipendeni was a service that was focused on the provision of information: it did not assist in the generation of an enabling environment that supports parents willing to adopt new practices. The behaviour change literature suggests that behaviour change interventions that provide both information and a supportive enabling environment may be more effective in changing behaviour (Briscoe and Aboud, 2012). To facilitate behaviour change, mobile phone-based services could be joined up with other ongoing interventions (e.g. livelihood improvement programmes or social protection programmes) that aim to alleviate poverty.

The business model evaluation highlights a trend towards mobile health services based on data and mobile money services. These emerging services might offer parents new opportunities to access financial services that could enable them to act on Wazazi Nipendeni plus mNutrition advice. Incorporating financial and transactional services (or tools) may prove to be more effective in changing behaviour than pure information services, given that mothers said that they were unable to implement advice because of a lack of financial resources.

Wazazi Nipendeni messages focused on how the health and nutritional status of children could be improved. However, the literature suggests that behaviour change messages may be more effective when framed to fit the characteristics of the intended recipient (Pelletier and Sharp, 2008). Poverty and worries about money were bigger concerns for many households than the family's nutritional well-being. Messages that highlight the economic incentives of changing childcare practices could be particularly effective: for example, messages could stress that breastfeeding saves money.

5.4.6 Pathways of behaviour change

Overall, the specific mechanisms of behaviour change are likely to be different for different types of mothers/fathers, and within different household and community-level settings. Also, childcare and feeding behaviours do not take place in a social vacuum, but are shaped by ideas and practices negotiated by the social groups in which they are necessarily embedded (Murdoch and Lowe, 2003).

Wazazi Nipendeni is not a stand-alone agent of change, but can facilitate change in combination with other information sources

Based on the qualitative data, most Wazazi Nipendeni users were already familiar with the content of the messages. The messages thus reminded them and reinforced existing knowledge. Both the quantitative and the qualitative data also indicate that most parents had at least one trusted source

of nutrition and health information (with government health workers being the favoured source). Wazazi Nipendeni users who heard the same information from different sources said they were more likely to trust and follow the advice. Receiving the same information through different communication channels increased parents' trust in the validity of the information and convinced many parents to try to implement the advice.

Mothers used Wazazi Nipendeni messages to convince their husbands about the necessity of better childcare and nutrition

Wazazi Nipendeni messages were able to trigger discussions with peers/husbands that could facilitate behaviour change. Several mothers said they had discussed the content of messages with their husbands, and that these discussions informed their decision to try to follow the advice. Mothers also frequently used the messages in an attempt to convince their husbands about the necessity of buying more nutritious foods for the children, or when asking for money to purchase these foods themselves. In most households, men were the primary breadwinners and also made all decisions regarding how and on what the household's financial resources were spent. According to many mothers, use of the messages to support intra-household spending negotiations was often successful as the messages gave their requests more weight and power to convince. Husbands were more likely to listen to and engage with these requests as they perceived the messages to be based on objective advice from government/national experts. This finding is supported by findings from the quantitative evaluation that suggest that mothers in the treatment groups shifted more money towards expenditure for their children than mothers in the control group.

5.4.7 Lessons learned and recommendations: factors that make mobile phone-based interventions effective in changing behaviours

Several features give mobile phones an advantage over 'traditional' channels for behaviour change communication:

- Mobile phones can provide tailored and time-sensitive information (e.g. specific information for each week during pregnancy) more effectively and with less effort than most other information sources, even in remote, inaccessible settings (as long as there is sufficient network coverage and access to mobile phones).
- Mobile phone-based text messages can convey sensitive information related to pregnancy and early childcare more privately than health workers often can (especially in overcrowded health facilities with no space for private conversations). This is especially appreciated by first-time parents, who can often lack the confidence to ask questions.
- Mothers often struggled with multiple demands on their time (including household duties, care commitments, and paid work outside the home) and were therefore unable to attend health clinics regularly (e.g. for child growth monitoring). Wazazi Nipendeni's mobile phone-based information was valued as it could be read flexibly whenever and wherever mothers had time (as long as they had access to the mobile phone).
- Frequent Wazazi Nipendeni text messages satisfied mothers' need for continuous reassurance, support, and feedback from a credible, trusted source; this need could usually not be adequately addressed by public health workers, who saw mothers only infrequently and often worked under extreme time pressures. To ensure Wazazi Nipendeni messages effectively address mothers' need for continuous support (especially during critical times, such

as shortly before and after birth and during initiation of breastfeeding) messages need to be sent out with a reliable frequency (e.g. several times a week).

- In a context of overcrowded and understaffed public healthcare services, mobile phone-based information services can offer a low-cost mechanism for reaching mothers (and fathers) more frequently. This can help to strengthen the existing healthcare system.

There was also a critical shortcoming of Wazazi Nipendeni that needs to be addressed to increase its effectiveness for behaviour change:

- The transmission of text-based information to passive audiences without an element of interactive engagement is likely to have limited the effectiveness of Wazazi Nipendeni in changing behaviour significantly, as users did not experience any peer, social, or emotional support when attempting to adopt the advice that Wazazi Nipendeni provided. Social support has been shown to be critical in effective behaviour change interventions (especially for breastfeeding and other IYCF practices). Introducing interactive components into mobile phone-based services (e.g. a well-functioning call centre) and/or human support is likely to increase their effectiveness in changing behaviours drastically.

Other findings regarding the effectiveness of mobile phone-based services (and Wazazi Nipendeni specifically) to change behaviours include the following:

- While Wazazi Nipendeni provided information tailored to users' specific needs (e.g. stage of pregnancy), the service did not support the generation of an enabling environment that supports parents willing to adopt new practices. To increase the effectiveness of mobile phone-based behaviour change interventions, they could be joined up with other ongoing interventions (e.g. livelihood improvement programmes or social protection programmes), or mobile money services, that provide parents with the financial resources to act on the advice (e.g. to buy animal-sourced food to feed to their children).
- Mobile phone-based advisory services such as Wazazi Nipendeni are unlikely to be effective as a stand-alone channel for behaviour change: they are likely to perform best when integrated with traditional media and channels (e.g. health facilities) as part of a multilevel strategy that conveys the same messages using multiple approaches (which Wazazi Nipendeni already does). Mobile phone-based information could thereby be one part of a broad, many-pronged policy, and not the only component aiming to change behaviours and practices.
- Mobile phone-based information from a source that is perceived as credible (such as the government) can help to enhance mothers' bargaining power in intra-household spending negotiations by convincing fathers to take more responsibility in regard to childcare-related activities. Many fathers were more likely to listen to and engage with such requests from their wives as they perceived the messages to be sent by sources they respected. To further promote this mechanism of change, messages could (gently) promote the use of the Wazazi Nipendeni content in intra-household decision-making processes.

5.5 Commercial viability of business models for Wazazi Nipendeni

This section answers the evaluation question – How commercially viable are the different business models for a mobile phone-based platform such as Wazazi Nipendeni? And how cost-effective is Wazazi Nipendeni?

5.5.1 Recap of mNutrition and Wazazi Nipendeni

The mHealth Tanzania-PPP is funded by public money (from international donors) and the service is enabled by the charitable donation of SMS messages by the MNOs. The costs of developing the Wazazi Nipendeni service have been covered by CDC, as part of its public health programmes. The costs of developing the additional nutrition content have been covered by the mNutrition programme.

The original mNutrition project design was based on an assumption that users would pay for information (e.g. via subscriptions), and that this would provide opportunities for participating organisations to develop commercially sustainable business models, even though nutrition information was to be made available using a ‘freemium’ model, under which it would not be charged for. However, the Government of Tanzania insisted that health information should be made available to citizens free of charge. Therefore, Wazazi Nipendeni has no direct revenue stream.

5.5.2 The Wazazi Nipendeni product

Wazazi Nipendeni is seen as offering a valuable service by users who received and used it. Based on the quantitative evaluation, over 80% of households who successfully received Wazazi Nipendeni messages read all the messages they received, and over 90% of these users either always or very often found the messages useful. Users also expressed high levels of satisfaction with the service, as over 90% of users would recommend the service (i.e. said they were likely or highly likely to recommend it to others). There is evidence that users translated information from the messages into action (see Section 5.2).

The quantitative evaluation has shown that the Wazazi Nipendeni service yielded substantial indirect benefits to mobile operators in terms of increased ARPU. Control households spent an average of TZS 5,300 per month (£1.90/month) on mobile phone airtime (including any data bundles), but spending was 10% higher (TZS 510, £0.18/month) in treatment communities. Indeed, it is worth noting that the effect size among users is possibly even higher because this 10% increase in spending was the average measured across the treatment communities as a whole, which included both users and non-users.

The qualitative evaluation found that women using the Wazazi Nipendeni service became more confident in using their phones, which explains the increase in ARPU. The quantitative evaluation found they were more likely to make and receive calls, more likely to have sent and received text messages, more likely to have used mobile money services, and more likely to have used their phone intensively¹⁵ (see Section 5.2).

This represents a real financial benefit to MNOs as a result of their contribution to Wazazi Nipendeni. As the real cost to an MNO of sending SMS messages is low (tending to zero), there is only minimal cost of sale associated with this increase in revenue. It is therefore possible to develop a business case for MNOs to provide an mHealth service on the basis of indirect benefits, should this be the model that is transferred to another country. Moreover, if there is a commercial

¹⁵ Defined as using their mobile phone on most days during the past 14 days.

case for MNOs to provide an mHealth service, then there is also a case for a third party to provide content on a revenue-sharing basis (as with conventional VAS).

5.5.3 SMS remains an appropriate channel for delivering information in Tanzania

Wazazi Nipendeni was highly valued by users and messages were commonly read (see Section 5.3). Having said that, it might be the case SMS may be particularly well suited to the Tanzanian context, given that literacy levels are relatively high compared to much of sub-Saharan Africa and the country is united by the language of Swahili.

5.5.4 Wazazi Nipendeni is based on a complex set of partnerships implemented by the mHealth Tanzania-PPP

The success of the mHealth Tanzania-PPP in implementing a nationwide information dissemination service such as Wazazi Nipendeni (and other services) is a result of a long history of investment, partnership brokering, and political commitment. This does not necessarily mean that a start-up could not achieve something similar, but overcoming the complexity and diversity of the partnerships involved has not been a trivial achievement.

Wazazi Nipendeni is unique in the complexity of its underlying partnerships and these have been crucial to accessing all the resources needed to make the service succeed:

- **Research and design.** Originally conceived as a prevention of malaria in pregnancy campaign, the mHealth Tanzania-PPP delivered the text messaging service as part of the campaign put together by Johns Hopkins Center for Communication Programs and the Ministry of Health and Social Welfare (now renamed MoHCDGEC).
- **Content.** Content development was led by and the Ministry of Health and Social Welfare, to ensure the messages were developed in line with government recommendations, and TFNC was instrumental in securing approval for content. Content on specific topics was developed in partnership with MNOs and foundations.
- **Technology platform.** The service was originally run on an open source platform developed by Text to Change (TTC) and was migrated to a new platform in October 2016, which was commissioned and paid for by MoHCDGEC (with CDC funding).
- **Telecoms operators.** The mHealth Tanzania-PPP had identified MNOs as key partners at the start. The Wazazi Nipendeni campaign was launched without explicit support from MNOs, but after the service achieved 100,000 users within 11 weeks MNOs then entered into agreements.
- **Field partners.** The programme launched in November 2012 with a two-month nationwide media campaign (radio and TV). A follow-up campaign ran from July 2013 to February 2014. A total of 24 field partners had formal agreements with the mHealth Tanzania-PPP. Analysis of registration data suggests that field partners may have assisted up to 83% of users to register.
- **Government agencies.** The Government of Tanzania is committed to a number of relevant health policies on nutrition, sexual and reproductive health, and maternal mortality, and a number of information and ICT policies, including open and accountable government and electronic access to health services.

Field partners are particularly important in getting users registered. For example, the National Health Insurance Fund has brought the largest number of users into the system. Opt-out data support the view that women who were helped with registration have a stronger commitment to the

service, stay on the service for longer, are more likely to read the messages, and are more likely to adopt improved behaviours.

These partnerships have been successful due, in part, to the personal skills and commitment of the mHealth Tanzania-PPP team. For example, rapid staff turnover within the MNOs continues to pose a challenge for the work of the mHealth Tanzania-PPP. When support was given as part of organisational corporate social responsibility activities, it depended on personal relationships, so effort was constantly required to establish relationships with new staff. As support for Wazazi Nipendeni becomes integrated into commercial operations, which is increasingly the case given developments in the political economy of the telecoms industry, the importance of personal relationships may diminish. CDC views the mHealth Tanzania-PPP as a success story, as it is rare to see a successful transition from a programme managed centrally by CDC to a country-held PPP managed locally, and especially one in which there is a true partnership with the national health ministry.

5.5.5 Tanzanian context

Political context and anti-corruption

Support for Wazazi Nipendeni has political capital in an environment that is characterised by pressure on telecommunications companies. For example, there have been ongoing disputes over the ownership of Tigo and Airtel in Tanzania, both of which stretch back over nearly two decades. In 2018, the CEOs of Halotel and Zantel were charged with fraud.¹⁶ More recently, in 2019, following the arrest of its CEO, Vodacom Tanzania pleaded guilty to the charge of intending to avoid paying taxes¹⁷ and had to make a \$2.3 million payment to the government. Previously, operators signed contribution agreements indirectly with the mHealth Tanzania-PPP, but as political pressure increased they moved to signing agreements directly with MoHCDGEC, better enabling them to leverage their contribution in any negotiations with the government.

Changing technology context

Although mobile subscriber numbers continue to grow, growth in internet subscribers is much greater. However, the majority of mobile internet connections are 2G, and Tanzania's broadband coverage lags behind its neighbours. Smartphone ownership stood at around 13% of adults in 2017, which is well below the median for sub-Saharan Africa (33%). This suggests that mobile data use is set to grow and there is indeed an appetite among mobile operators to increase access to the internet and data use.

Advances in technology are leading to a next generation of mHealth services that are smartphone-based and delivered over the internet. Increasing broadband coverage and falling smartphone prices mean that these services will be accessible to more of the population in the next few years. Many new services incorporate financial services, which can enable subscriptions, purchases (e.g. of pharmaceuticals), and insurance. These emerging services are attractive to MNOs as MNO-led mobile money services are a source of increasing revenue. Nonetheless, these services tend to be

¹⁶ <https://uk.reuters.com/article/us-tanzania-telecoms/tanzania-charges-telecoms-executives-with-fraud-in-tax-evasion-crackdown-idUKKCN1J22PD>

¹⁷ www.reuters.com/article/tanzania-vodacom-tanzania/update-2-vodacom-tanzania-pleads-guilty-settles-charges-against-ceo-employees-idUSL8N21T48S

accessible only to people with higher levels of digital literacy as they are more complex, so they carry a risk of opening up further digital divides.

5.5.6 Wazazi Nipendeni business model

The business model continues to be a ‘multi-sided platform business model’ where value is provided by enabling interactions between two or more customer groups. Wazazi Nipendeni provides value to funders with a health mandate (MoHCDGEC and CDC), who pay for the service, thereby enabling users to access it free of charge. This was described as a ‘donor-funded business model’ by GSMA in its country feasibility study (GSMA, 2014). One of the principal funders was MoHCDGEC. However, as the ministry assumes responsibility for more of the activities conducted by the mHealth Tanzania-PPP, including the Wazazi Nipendeni service, the business model will tend towards a hybrid of a government-to-citizen (G2C) model and the multi-sided platform, as the field partners will still support both Wazazi Nipendeni and users, and the MNOs will still provide in-kind funding for messages.

The principal vulnerabilities of the current business model are its dependence on continued funding from CDC (or other donors) and continued goodwill from the MNOs in providing free SMS messages. Through not yet secure, the mHealth Tanzania-PPP is currently engaged in negotiating renewed funding arrangements with CDC. The mHealth Tanzania-PPP is also continuing to enter into agreements with new public health programmes, and recent policy documents suggest that continued donor funding is likely to be forthcoming. The quantitative study provides robust evidence of a substantial increase in ARPU, which will be of value to the mHealth Tanzania-PPP as it negotiates continued and increased support from MNOs in the future.

5.5.7 Commercial business models for mHealth services

It is difficult to argue a case for the financial viability of the mHealth Tanzania-PPP because none of the partners generate revenue directly from providing the Wazazi Nipendeni service. Indeed, all parties are prohibited from generating direct revenue because the Government of Tanzania has ruled that all health services should be free to consumers.

However, the finding that Wazazi Nipendeni is linked to a real increase in operator revenue (as increased ARPU) opens up possibilities for more commercial business models, two of which are explored in detail below:

- **An in-house MNO service:** The MNO invests in localising content (assuming nutrition and maternal health content is in the public domain) and sets up an internal product development group to manage technical systems and to make alliances with national health programmes (in the same way as the mHealth Tanzania-PPP).
- **An independent but commercial content provider:** The provider invests in localising content (assuming nutrition and maternal health content is in the public domain) and manages both the technical systems and arrangements with national health programmes (in the same way as the mHealth Tanzania-PPP). It provides information services as a VAS to MNOs on a revenue-sharing basis.

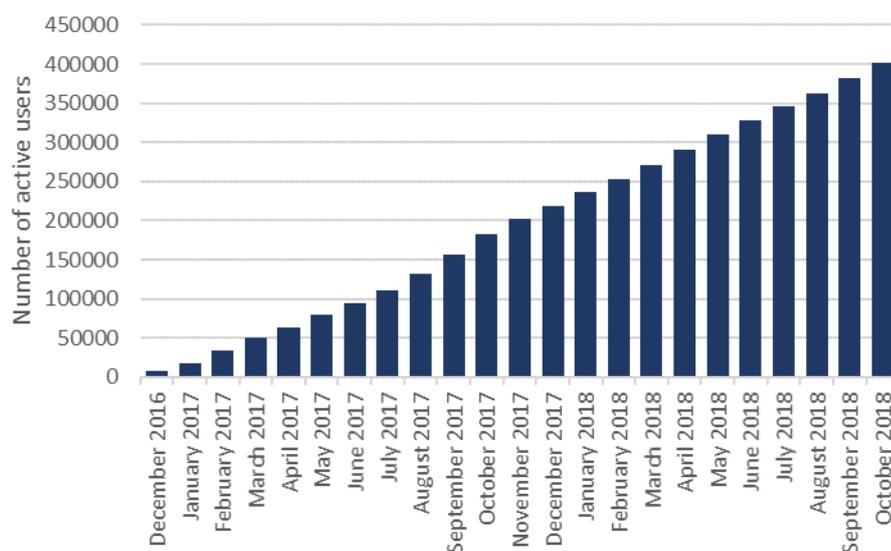
In order to explore these opportunities, a financial model has been created based on operating cost structure and cost data provided by Cardno, supplemented by data gathered through

interviews. These cost data include a quantification of in-kind contributions made by MNOs (donating SMS and USSD sessions).

In-house MNO service

There is a hypothetical business case scenario in which an MNO sets up an mHealth service in-house. In this model, the MNO would retain all of the additional revenue generated from any increase in ARPU, and there would be no real costs associated with the SMS messages sent. It is assumed that the hypothetical MNO-based service would start from scratch, with no pre-existing users, so the model is based on the profile of active users presented in Figure 9.

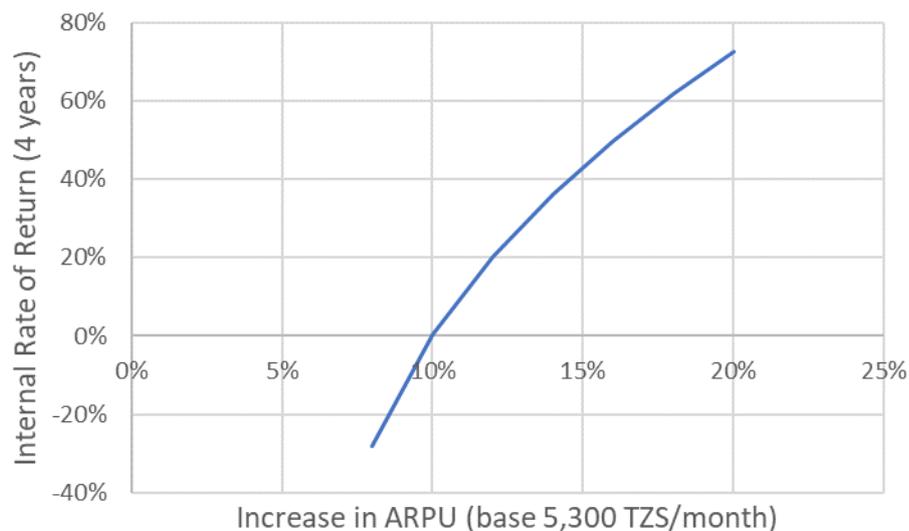
Figure 9: Growth in active users



Source: Authors' own

If SMS messages and USSD sessions are zero-rated then the service would break even in Year 3 (based on the assumptions implicit in the model), although it would not generate enough cash to provide a positive return on investment over a four-year period. Assuming the same trajectory of increasing users, the large number of users (rising to 1.1 million) would generate enough revenue to provide a 19% IRR in a five-year period.

As revenue is generated solely from increases in ARPU, the financial viability of such a VAS is highly sensitive to that increase. Up to this point, the analysis has been based on the TZS 510/month increase in ARPU found by the quantitative study (on a baseline level of an ARPU of TZS 5,300 among the control sample), i.e. an effect size of approximately 10%. This is based on the effect of the random offer of access to the service in the quantitative study (i.e. comparing ARPU between the treatment and control samples). This method of calculation is likely to underestimate effects, but the authors were unable to calculate more specific effects with any reliability because of inconsistencies in the self-reported access to the Wazazi Nipendeni messages. Figure 10 shows how sensitive the financial viability of a service is to this effect size, and that even if the effect size was marginally higher than 10% a service could be financially viable in a four-year period.

Figure 10: Sensitivity of IRR to increase in ARPU (in-house MNO)

Source: Authors' own

Consider a scenario in which an in-house mHealth VAS can be developed and delivered under the following assumptions:

- a 20% reduction in fixed operating costs (staff time and platform costs) – an MNO would be quite capable of setting up its own platform, which could reduce real costs still further;
- a nationwide ARPU of TZS 6,000 per month; and
- a 15% increase in ARPU when consumers use the mHealth VAS.

These positive assumptions indicate that such a service would be financially attractive, providing an IRR of approximately 70% over a four-year period. However, it should be noted that Wazazi Nipendeni, as a PPP, has gained users across all four MNOs and it is not clear whether an MNO in-house service would have the potential to reach as many users. Furthermore, while a government agency (e.g. the health ministry) might be keen to support an enterprise that is clearly for the public good, it may be more measured in its support for a private sector venture.

Commercial content provider

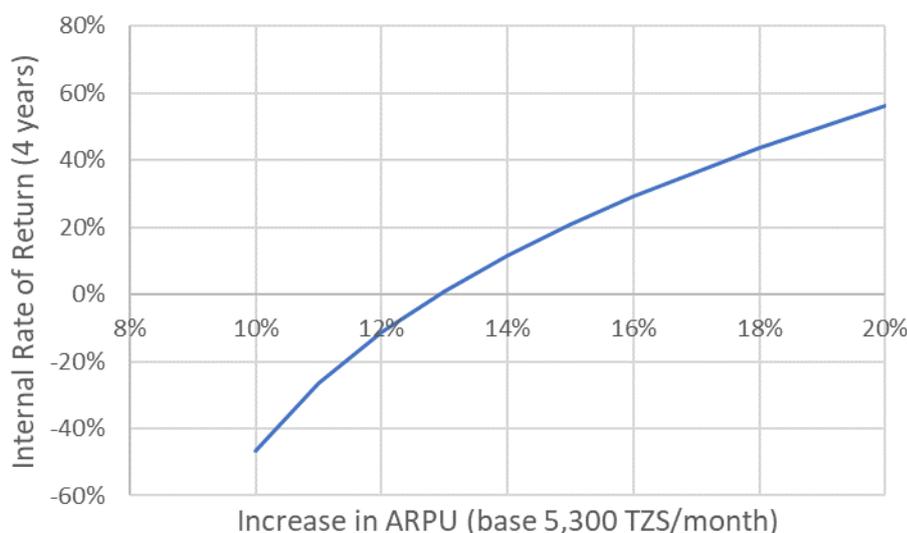
Less attractive, although possibly still viable, is an independent content provider model. The same investment costs have been assumed, but the provider would need to pay a bulk SMS price for all messages sent (TZS 25 per SMS) and would need to enter into some kind of revenue-sharing agreement with each participating operator.

At a 100% revenue share with MNOs (i.e. all TZS 510/user/month in increased ARPU goes to the content provider), the model suggests the service would break even at the beginning of Year 3. However, the rate of return on investment over a four-year time horizon would be negative. Given the assumed trajectory of growth in user numbers, much greater revenues are generated if the timescales can be extended. Therefore, at 100% revenue share, the service could generate a positive IRR of 4% over a six-year period. However, rate of return is highly sensitive to revenue share: at 90% revenue share (i.e. the MNO retains only 10% of the increase in ARPU), the IRR turns negative.

As revenue is generated solely from increases in ARPU, the financial viability of such a VAS is highly sensitive to that increase. Up to this point, the analysis has been based on the TZS 510 per month increase in ARPU found by the quantitative study (on a baseline level of an ARPU of TZS 5,300 among the control sample). As described above, this is likely to be an underestimate and the real effect size could be double that.

Figure 11 shows how sensitive the financial viability of a service is to this effect size, and it shows that if the effect size was 15% then a service could be financially attractive over a four-year period. The effect size among users could be double (20%), in which case the return on investment would be highly attractive. The revenue share for the figure is 90%.

Figure 11: Sensitivity of IRR to increase in ARPU (content provider)



Source: Authors' own

Consider a scenario in which an independent mHealth VAS provider can develop and deliver an information dissemination service under the following assumptions:

- a 20% reduction in fixed operating costs (staff time and platform costs);
- a nationwide ARPU of TZS 6,000 per month;
- a 15% increase in ARPU when consumers use the mHealth VAS;
- a 50% revenue share with MNOs; and
- an SMS price of TZS 25.

These positive assumptions indicate that such a service could generate a positive IRR of 6%, but only over a six-year period.

5.5.8 Cost-effectiveness

The quantitative component found **no evidence that access to the mNutrition service had any impact on child nutrition**, as measured by anthropometry (HAZ, WHZ, stunting, wasting): the ITT analysis found no evidence of a difference between treatment and control groups. Results for the other primary and secondary outcomes are more positive, however. **The offer of access to the mNutrition service improved dietary diversity and adequacy for children.** Children aged 6–35

months in treatment villages consume from 0.11 more food groups.¹⁸ The literature shows that the number of food groups consumed has an effect on stunting in children aged 6–23 months (Khamis *et al.*, 2019). Using this link, the effect of increasing dietary diversity by 0.11 food groups corresponds to an effect on stunting of an increase in HAZ scores by 0.008. We acknowledge that trying to link dietary diversity or nutrient adequacy to DALYs could be challenged, particularly in light of the study that showed there was no evidence that access to the mNutrition service had any impact on child nutritional outcomes. However, in doing so **we make an assumption**: that over the longer term the changes in dietary diversity may cause changes in stunting. **The resulting analysis presented here is therefore at risk of being generous to the programme and policy actors need to be aware of that.**

Using Global Burden of Disease data, stunting is classified as a risk factor and the associated burden on children aged 6–35 months is estimated to be 154,100 DALYs in Tanzania. A reduction in the rate of stunting from 36.33% to 36.11% across the nationwide population of children aged 6–35 months (resulting from an increase in HAZ scores of 0.008) would reduce the number of cases of stunting by 9,440. A reduction in such cases by 9,440 represents 0.61% of the existing cases of stunting in this age group. If this saving were applied the burden of disease associated with a risk of stunting among the population of children in this age group, it would reduce the burden of disease by 935 DALYs (0.61% of 154,100 DALYs).

Wazazi Nipendeni subscribers represent roughly 12.8% of the 4.28 million children in Tanzania estimated to be aged 6–35 months. Therefore, Wazazi Nipendeni's effect corresponds to a reduction in the health burden of roughly 119 DALYs (ITT) (12.8% of 935 DALYs). However, the LATE estimations are closer to representing the 550,000 users and we choose to use the LATE estimations of the dietary diversity changes in the age group. The LATE estimation produced by the quantitative component of the evaluation increases the number of food categories that children consume by 0.263. This is more likely to represent the change found in the 550,000 users. Given this focus on the treatment take-up, the DALYs averted rises to 286 DALYs.

Taking the LATE estimates as more representative of the effect on users, 286 DALYs suggests a **cost per DALY averted of £9,776** (with a range of £4,132 to £16,755 (2019 prices)). Even at the lowest estimate, this exceeds the WHO Commission for Macroeconomics and Health (WHO, 2001) guideline for a cost-effective intervention (i.e. <3 times per capita GDP; the GDP of Tanzania is £622 per capita¹⁹).

5.5.9 Realising the vision for mHealth services

PPP vision

Looking back on the development of the mHealth Tanzania-PPP and the Wazazi Nipendeni service, it is interesting to see how the strategy articulated at the baseline has largely come about, with more partners entering into agreements with the mHealth Tanzania-PPP to provide mobile

¹⁸ The LATE estimate for this indicator is 0.16.

¹⁹ 'An intervention is considered very cost-effective, if the monetary amount spent on the intervention per disability-adjusted life year (DALY) saved is less than the per capita gross domestic product (GDP) for the nation in which the intervention is applied.' 'An intervention is considered (moderately) cost-effective, if the monetary amount spent on the intervention per DALY saved is less than three times the per capita GDP.'

phone-based services, and with the government getting more involved and assuming more responsibility for the platform.

As part of this evolution, the primary role of the mHealth Tanzania-PPP appears to have shifted from technical to health. The PPP was originally set up to develop the software and systems needed to deliver a service, but an understanding of public health now seems to be more important in dealing with MoHCDGEC and negotiating partnerships with health partners.

GSMA vision

It is also interesting to note that the current model closely resembles the original concept for the 'one-stop shop' articulated by GSMA at the beginning of the mNutrition programme. The mHealth Tanzania-PPP is the 'go-to' institution in Tanzania that can help programmes entering the country to set up mobile services more conveniently, at a lower cost, and avoiding duplication, rather than setting up independent services themselves.

The significant difference is that, although the mHealth Tanzania-PPP moderates a complex partnership of public and private institutions, it is itself effectively a public body. It is funded by public money through CDC and has no desire to become a for-profit organisation. The original GSMA vision was for a private body to act as the aggregator, or at least as a form of cooperative that would generate revenue to cover costs.

5.5.10 Lessons learned and recommendations: a commercially viable business model for mobile phone-based information services

- The study highlights the importance of a long history of investment, partnerships, and political commitment in nurturing a facility to the point where it can successfully implement an information dissemination service (and others) at national scale. Donors need to be aware of the importance of a foundation upon which innovative services can build.
- The ability to broker a complex set of partnerships with a diverse range of stakeholder groups has been crucial to the success of the service. These partnerships have been successful due, at least in part, to the personal skills and commitment of the mHealth Tanzania-PPP team.
- Field partners play a crucial role in providing a face-to-face presence that supports users by getting them registered, reinforcing messages, and enhancing the effectiveness of the service.
- The Wazazi Nipendeni service yields substantial indirect benefits to mobile operators in terms of increased ARPU. The effect size was at least a 10% increase in ARPU (510 TZS per month), and is likely to be higher still. This is possibly as a result of women becoming more confident in their use of phones. There was no evidence that Wazazi Nipendeni users held on to their SIM cards for longer (reduced churn). MNOs provide zero-rated SMS as part of their corporate social responsibility, and yet they are getting an indirect benefit that gives them revenue that exceeds their 'donation', even when that donation is assigned a retail SMS value.
- Given that MNOs are deriving real financial benefit from the partnership, further research is required to identify a mechanism whereby content created using public funds can be paid for through some form of revenue share of the financial benefit yielded by the services that exploit that content.
- Demonstrating that Wazazi Nipendeni generates real revenue for operators opens up possibilities for alternative commercial business models. Our analysis has focused on two hypothetical cases: a) replicating an mHealth agency, delivering a service similar to Wazazi

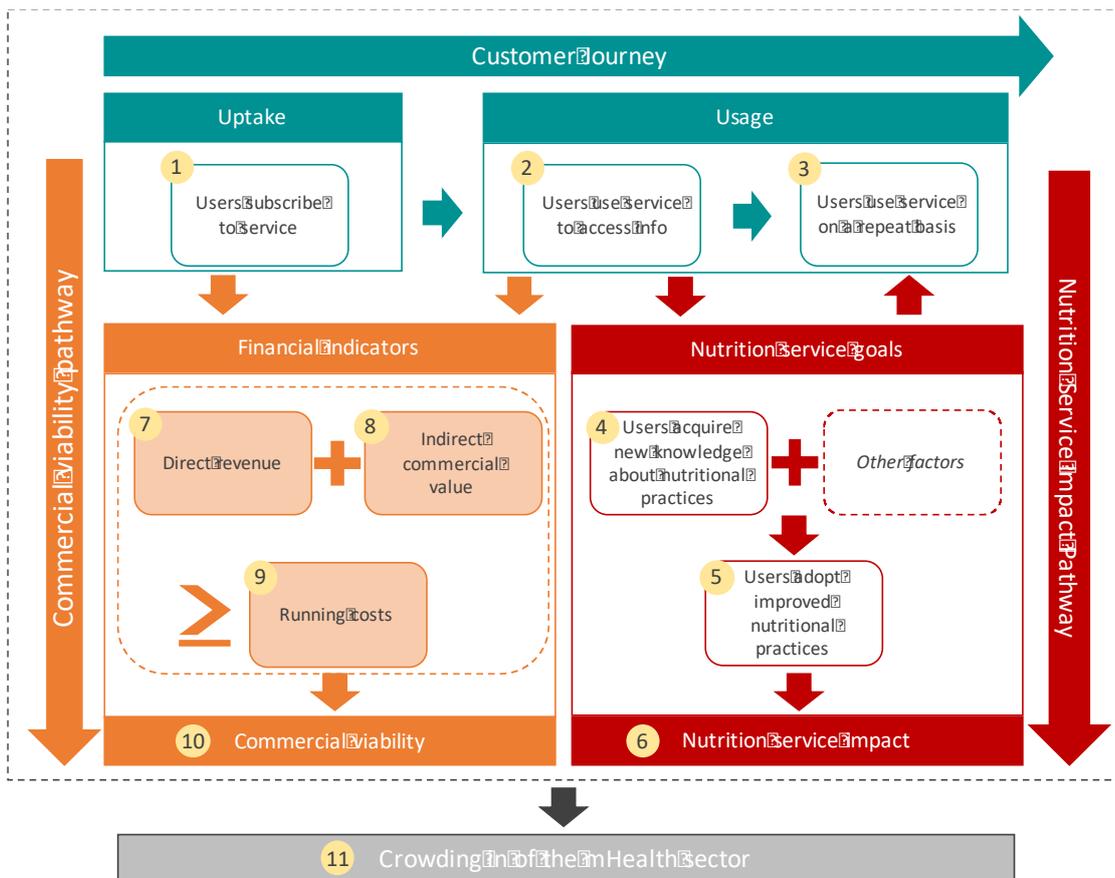
Nipendeni, in another country (an MNO-led in-house mHealth service); and b) an independent content provider.

- An in-house mHealth service developed by an MNO appears to be the most attractive proposition for two reasons. First, all of the increase in revenue is retained by the MNO and, second, the real cost to an operator of sending SMS messages is minimal. Modelling a scenario based on positive assumptions on operating costs, ARPU, and effect size (increase in ARPU) indicates that a service could provide an IRR of approximately 70% over a four-year period.
- Less attractive, although possibly still viable, is an independent content provider model; the provider would need to pay a bulk SMS price for all messages sent, and it would need to share revenue with each participating operator. A scenario based on positive assumptions on operating costs, ARPU, effect size (increase in ARPU), and revenue share (50%) indicates that a service could only provide a positive IRR over a six-year period. However, it is unlikely that an aggregator could convince an MNO to share 'increased ARPU' – as an indirect benefit, tracking and allocating this would be a challenge.
- None of the partners was permitted to charge for health services, so the Wazazi Nipendeni business model continues to be a multi-sided platform business model that provides value to funders with a health mandate (MoHCDGEC and CDC) who pay for the service, thereby enabling users to access it free of charge. One of the principal funders was MoHCDGEC, but as this ministry assumes responsibility for more of the activities conducted by the mHealth Tanzania-PPP, including the Wazazi Nipendeni service, the business model will tend towards a hybrid of G2C and the multi-sided platform, as the field partners will still support both Wazazi Nipendeni and users, and the MNOs will still provide in-kind funding for messages.
- In the event that a health information service provider is permitted to levy charges, possible mechanisms for revenue generation include charging NGO / government clients, sponsoring of messages as a form of advertising (e.g. by fast-moving consumer goods companies), and commission from sales of private health sector financial products (e.g. life insurance).
- Telecommunications companies have come under pressure from the government as part of its anti-corruption campaign. Support for Wazazi Nipendeni has political capital in this context, and operators have now signed agreements directly with MoHCDGEC, rather than indirectly with the mHealth Tanzania-PPP. Previously, operators' promotion of Wazazi Nipendeni has been weak so they should be supported to capitalise on Wazazi Nipendeni's positive brand.
- Despite the vulnerabilities in the current business model in regard to continued funding from CDC, as well as free SMS messages continuing to be donated by MNOs, the model articulated by the mHealth Tanzania-PPP appears to be sustainable. The mHealth Tanzania-PPP continues to enter into agreements with new public health programmes, recent policy documents suggest that continued donor funding is likely to be forthcoming, and negotiations with CDC for renewed donor funding are at an advanced stage. There may be merit, therefore, in the donor-funded business model.
- Although SMS remain an appropriate medium for reaching women, data-based services may split the market. Emerging mHealth services exploit the potential of the internet, of smartphones, of data acquisition and analysis, and of mobile money services. This is consistent with trends in the telecoms market of growth in data and mobile money. mHealth services will need to be agile as they incorporate emerging technologies into their service offering.
- The cost-effectiveness based on DALYs averted, even with the most favourable assumptions, does not fit within the WHO guidelines for an acceptable intervention.

6 Assessment of the assumptions that underpin the ToC

Wazazi Nipendeni was expected to improve health and nutritional outcomes while generating direct revenues and indirect commercial value for mHealth Tanzania-PPP (see Section 2.2). This section will revisit the mHealth ToC, and in particular the assumptions that lay behind each component of the ToC (i.e. customer journey, nutrition service impact pathway, and commercial viability pathway). For each assumption we assess whether the assumption ‘holds true’, ‘partially holds true’, or ‘largely does not hold true’, using evidence from all three evaluation components.

Figure 12: mHealth Theory of Change



Source: GSMA and Altai (2017)

Table 6 presents the assessment of the assumptions that underpin the customer journey. As can be seen, the majority of assumptions held true or held at least partially true in practice. Gendered barriers to the access to mobile phones, lack of electricity, and mistaking Wazazi Nipendeni messages for mobile spam were identified as barriers to mobile phone-based information services in Tanzania. The assumption that did not hold true was that the Wazazi Nipendeni service was successfully delivered to users’ phones: in fact, a large proportion of users never received the service or received text messages only for a limited time, and then the service stopped without obvious reasons. To facilitate a more effective and successful take-up of Wazazi Nipendeni, extra effort would have to be put into ensuring that households successfully receive the text messages.

Key:

	Assumption holds true
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	Assumption partially holds true
	Assumption largely does not hold true
	Insufficient information/not applicable

Table 6: Customer journey

Assumptions	Rating	Comment
Pregnant women and mothers can access mobile phones to subscribe to and use the service		Only 60% of women in rural Iringa own a mobile phone; there are considerable gendered barriers to access to mobile phones as husbands often strictly control and monitor access; poor households are excluded from the service as they cannot afford a phone
Pregnant women and mothers of young children can get sufficient signal coverage and strength to subscribe to and use the service		Wazazi Nipendeni is offered by all MNOs in Tanzania. While there are small network coverage gaps within some villages, people usually know where in the village they can get a network connection
Pregnant women and mothers are literate and comfortable with receiving SMS messages		Most women were literate and comfortable with receiving SMS messages
Pregnant women and mothers have enough money to use the service		Wazazi Nipendeni is available free of charge to all users
Pregnant women and mothers have access to electricity to charge their mobile phones regularly		Only 46% of women had access to electricity to charge their phone at home. Households without access charged their mobile phones for a fee at the nearest mobile phone kiosk (and if both husband and wife owned a mobile phone, charging the husband's phone was usually given priority)
There are no social norms or attitudes that may hinder pregnant women and mothers from engaging with mobile phone-based information services		There are no social norms that hinder engagement with mobile phone-based information services; however, there are gendered barriers to the access to mobile phones
Unwanted mobile spam does not interfere with/distract from the mNutrition service		Mobile spam is a considerable challenge in the context of rural Tanzania. As the Wazazi Nipendeni messages are sent without a clearly identifiable sender name but from a number that is very similar to the numbers used by spam, many users mistook messages for spam
Pregnant women and mothers find the service useful and use it repeatedly		Overall acceptance and perceptions of the usefulness of the Wazazi Nipendeni messages were high
Service is successfully delivered to mothers' mobile phones		A considerable proportion of treatment households never received Wazazi Nipendeni messages, or only received messages for a short time before the service stopped without an obvious reason (i.e. despite them still using the same MNO and SIM card than used for subscription)

Source: Authors' own

Table 7 shows the assessment of the assumptions that underpin the pathway of change of Wazazi Nipendeni. Most assumptions held true or partially true, except the assumptions related to the access to resources to act upon the Wazazi Nipendeni advice. Lack of financial resources emerged as a major barrier to translating the advice into practice.

Table 7: Nutrition service impact pathway

Assumption	Rating	Comment
Pregnant women and mothers have information gaps related to nutritional practices		While general knowledge related to nutrition practices was already relatively good, there were gaps with regard to the practical implementation of the knowledge, as well as specific practices
Pregnant women and mothers lack access to credible information on nutritional practices		Nearly all women had access to credible information through government health workers. However, contact with health workers was infrequent, health facilities were often overcrowded and overstretched, and health workers had little time to provide advice
Pregnant women and mothers perceive the information as credible and trust the information provided		Nearly all women trusted in the credibility of the content of Wazazi Nipendeni messages
Pregnant women and mothers perceive the information as actionable and context-relevant		While many of the messages were perceived as actionable and context-specific, many also merely repeated high-level recommendations, without providing further details
The information provided is accurate and correct		Quality control of the message content was very high and was conducted by partnership organisations
Pregnant women and mothers understand the information provided (both language and content)		No problems with the understandability of the content or language were found. However, content was often simplified to fit within 160-character text messages, and lacked contextualisation
Improved drinking water sources and sanitation are available		Only 75% of all households had access to improved sanitation and only 82% had access to improved drinking water sources. The remaining households had to rely on unsafe, unimproved sanitation and/or water sources
Pregnant women and mothers have access to and use antenatal care services		Nearly all women used antenatal care services (although many delayed their first visit)
Pregnant women and mothers have sufficient time and resources to improve child feeding practices		Lack of money to purchase better and more varied food was a major barrier to the translation of the Wazazi Nipendeni advice into action. Work commitments emerged as a major barrier to exclusive breastfeeding
Pregnant women and mothers implement the nutrition advice correctly		Mothers adapted advice to their financial conditions and capacities if necessary
Pregnant women and mothers act on the new information and change their nutritional practices		The evaluation found small improvements in dietary diversity but no improvements in nutritional status outcomes
Pregnant women and mothers have the power to make decisions based on the advice received		In most households, mothers are responsible for childcare and feeding; however, they are not in control of household resources and often had to negotiate with husbands regarding the implementation of the advice
Pregnant women and mothers have access to fresh foods		At least some fresh food was available but it was often not economically accessible

Source: Authors' own

Table 8 presents the assessment of the assumptions that underpin the sustainable commercialisation pathway of Wazazi Nipendeni. As can be seen, the majority of assumptions hold true in practice.

Table 8: Commercial viability pathway

Step	Rating	Comment
mNutrition services target viable customer segments		Field partners have facilitated large numbers of registrations and drop-out rates are relatively low, suggesting the service is valued by consumers. No comment can be made on the financial viability of users because they were not charged for the service
The value proposition of the service satisfies the identified customer segments		Quality and satisfaction metrics were high. Over 80% read all messages received. Over 90% of these users found the messages useful (always or very often)
Channels for reaching the customer remain in place and customer relationships are able to reach and maintain the desired customer segments		Field partners provide face-to-face contact, with multiple benefits not only with regard to assisted registration but also reinforcing messages, accessing health services, etc. Although the service is available to all, the majority of users were signed up by field partners, who tend to focus programmes on rural and low-income communities
Revenue streams, both direct and indirect, fulfil the key performance indicators required by the supply partners		There were no direct revenue streams as MoHCDGEC prohibited charging users. MNOs had no concrete key performance indicators as donations were part of corporate social responsibility
Seeing the performance of the product, resources are made available from key supply partners		In the early days, MNOs partnered with Wazazi Nipendeni after they saw the rapid rise in the numbers of users. Field programmes continue to enter into partnerships with the mHealth Tanzania-PPP to offer the Wazazi Nipendeni service. CDC and MoHCDGEC are negotiating a further phase of support
Key partnerships in the supply chain are valued by each partner and maintained		Health programmes value the role that the mHealth Tanzania-PPP plays in providing the Wazazi Nipendeni service
A balance of cost, expenditure, investment, and income, both direct and indirect, make for sustainable commercialisation of the product		The service is prohibited from generating direct income. The feasibility of possible B2B revenue streams (e.g. advertising) remains untested. Indirect income (>10% increase in ARPU) is substantial and enough to make a hypothetical business case. The feasibility of non-financial factors (e.g. government endorsement) remains untested
Alternative approaches found in-country do not supersede the value proposition of the product		Other mHealth services in the country tend to complement (and integrate with) Wazazi Nipendeni, rather than compete with it. Emerging mHealth services will exploit the potential of the internet, data, and mobile money services. For the foreseeable future, SMS will remain appropriate for reaching large numbers of women, but emerging services may split the market

Source: Authors' own

7 Discussion

This section will outline how the mNutrition evaluation findings compare to the current evidence and existing literature within the field. It will also draw parallels to the evaluation of the mNutrition programme in Ghana that was conducted at the same time (Barnett *et al.*, 2020).

7.1 Reach, engagement, and uptake by target population

In Tanzania, the reach and uptake of mNutrition services among the target populations was lower than expected. The evaluation of mNutrition in Ghana came to a similar finding. In both contexts this can be explained by shortcomings in: (1) the available supportive infrastructure; (2) limited capacity of the intended target group; and (3) issues in the implementation and design of the programme. All three shortcomings were echoed in the wider literature on mobile phone-based interventions that aim to change behaviours in low- and middle-income countries.

Firstly, shortcomings in the available supportive infrastructure have been identified as a key limiting factor to the effective uptake of mobile phone-based interventions targeted towards behaviour change in the existing mHealth literature. For example, a recent systematic review of the mobile phone-based interventions to overcome child undernutrition in developing countries concluded that low network capacity and limited access to mobile phones were major barriers to reach (Seyyedi *et al.* 2019). In their recent review of enabling and inhibiting factors for mHealth adoption in low-income countries, Aamir *et al.* 2017 found that limitation in the mobile infrastructure and access to electricity frequently hindered reach and uptake. Larsen-Cooper *et al.* (2015) review the use of mHealth in low- and middle-income countries, stating that it is often the target groups of such programmes who have the least access to mobile phones and the necessary related infrastructure.

The second barrier was the limited capacity of users to engage with mNutrition messages as a result of illiteracy, as well as limited access to phones for some groups, an issue that again resonates with the wider literature on this subject. Osborn (2013), reporting on findings from mHealth evaluations in Uganda and Ghana, found that SMS alone is not efficient in reaching poor groups, due to literacy issues and low levels of education. MacPherson and Chamberlain (2013) reviewed mHealth programmes in India, noting that services needed to take into account the low levels of technological capacity of the target group, as well as ensuring appropriate language, vocabulary, and context were used. Murdoch and Lowe (2003) found that within childcare and feeding behaviour change programmes, acknowledging the social setting in which target groups or individuals exist will further improve reach and uptake was essential. Women are widely reported to have more limited access to mobile phones than men (Larsen-Cooper *et al.*, 2015; MacPherson and Chamberlain, 2013; Jennings, 2015; Crawford *et al.*, 2014; Datta *et al.*, 2014). Ensuring the information service matches the capacity of the target group will therefore increase the effectiveness of programmes (Pelletier and Sharp, 2008).

The final barrier was that of the design of the service, for example a lack of human support to encourage trust in the service and encourage continuous engagement, and problems of changing SIM cards and phone numbers disrupting service use. Aker *et al.* (2016) and Fabregas *et al.* (2019) found that design features (within mAgri programmes) that include face-to-face interactions with trusted sources may increase uptake, as well as recognition that the messages are useful and not spam. In mHealth evaluations in Uganda and Ghana, Osborn (2013) found that mobile phone users often change phone numbers and SIM cards, requiring services to adapt to this issue, with the suggestion that phone numbers should not be used as an identifier.

7.2 Effectiveness of services at changing behaviours

The effectiveness of mNutrition services in changing behaviours at scale was limited. In Tanzania, we found that access to Wazazi Nipendeni had modest positive impacts on women's knowledge of IYCF practices and on dietary diversity for both women and children, while it had no effect at all on the nutritional status of children. In Ghana no impact could be found on either knowledge or behaviour. In contrast, a review by Orr and King (2015) on the efficacy of SMS messages to enhance healthy behaviours found small positive effects of SMS on a broad range of health-promoting behaviours. However, most SMS-based interventions that were included in the review targeted only one specific health behaviour (rather than a multitude of behaviours such as in mNnutrition) and delivered SMS very frequently (usually daily or at least several times a week). Other recent reviews on mobile phone-based behaviour change communication to improve health and nutrition-related behaviours in pregnancy, postnatal and in early childhood all found small but positive impacts, especially if the interventions were well-targeted, based on formative research and addressed a limited number of key behaviours (rather than a wide range of different behaviours) (Mbutia et al. 2019; Mildon et al. 2019; Lee et al. 2016; Graziose et al. 2018).

Several studies also suggest that mobile phone-based interventions aiming to change behaviour can only be effective if they also consider underlying social and environmental factors that may pose barriers to change (Briscoe and Aboud, 2012; Higgs et al., 2014; Waisbord, 2014). Higgs et al. (2014) found mobile phone technology to be effective in changing mothers' knowledge of healthcare practices; however, the same technology could not address the poor social standing and treatment of mothers in the wider community, preventing them from applying the newly acquired knowledge. Mobile phone messages may raise awareness of optimal complementary feeding practices, but without economic and cultural access to the right foods these practices cannot be operationalised (Higgs et al., 2014; Waisbord, 2014; Barnett et al., 2016). Mildon and Sellon (2019) reviewed 64 studies on the use of mobile phones for behaviour change communication to improve maternal, newborn, and child health. They found that evidence of behaviour change remains limited but that, in some specific settings, where messages convey a simple message such as use of SMS to remind people to attend appointments, positive change has been reported. More complex behaviours usually need more complex interventions to be changed successfully.

Including a multi-platform approach, as well as interactive and or face-to-face elements, within mHealth programmes is widely suggested to be one way to increase the effectiveness (as well as the reach) of behaviour change programmes. This would also help to overcome the barrier of the limited capacity of some users to engage with programmes that are restricted to just mobile phone platforms. Briscoe and Aboud (2012) found that health behaviour change interventions are most effective if they use a multilevel approach to modify behaviour at different levels of the community in parallel, a finding echoed by MacPherson and Chamberlain's 2013 review of the Ananya Programme in India. The availability of real-time human support (e.g. through a call centre or face-to-face meetings) has been shown to increase continued engagement with digital behaviour change interventions (Michie et al., 2017). The literature further suggests that interactive digital interventions in which users are given the opportunity to contact experts for advice report higher levels of engagement than one-way interventions (Couper et al., 2010).

7.3 What makes mobile service different, compared to traditional channels?

A range of factors give mobile phones an advantage over 'traditional' channels for behaviour change communication. The tailoring of messages, the frequency of messages, the privacy that is afforded by personal messages, and the fact that they can be read at any time are all important for mothers, who struggle with multiple demands on their time. In a context of overcrowded and understaffed public healthcare services, mobile phone-based information services can offer a low-cost mechanism for reaching parents.

The ubiquity of mobile phones makes it possible to reach and contact target audiences for behaviour change interventions at all times and in a cost-effective manner, overcoming issues with 'contactability' which often poses a challenge for 'traditional' behaviour change interventions, especially in geographically spread-out populations (Hall *et al.*, 2014; Chan and Kaufman, 2009). Mobile health programmes will also offer solutions in settings where there is a shortage of healthcare workers and supervisor systems for these workers are weak (Kahn *et al.*, 2010). Moreover, mobile phone-based information services have fewer adoption barriers than 'traditional' interventions (Chan and Kaufman, 2009). Another potential strength of mobile phone-based behaviour change may be that participants often perceive the anonymous provision of information as less stigmatising than face-to-face counselling (Fielden, 2011). Chakraborty *et al.* (2019) found that mobile phone technology also assisted with monitoring and evaluating a mobile phone-based behaviour change campaign on maternal and child nutrition and allowed corrective action to be taken in a timely manner, when problems were identified.

Kahn *et al.* (2010) review various mHealth applications, and argue that alongside the advantages listed above there are other important benefits provided by mobile phone-based services within the healthcare sector. These include disease surveillance and response (particularly in epidemic or pandemic situations – something we have witnessed globally in recent months in dealing with COVID-19), shared resources and information exchange between providers as well as practitioners, and the provision of training to healthcare providers via mobile phone-based services.

7.4 What does the mNutrition evaluation add to the emerging evidence base on mobile phone-based advisory services?

The evaluation of the mNutrition programmes confirms, quantifies and explains many of the current challenges and limitations of mobile phone-based advisory services and also supports some of their previously reported successes (e.g. increase in knowledge of users, moderate changes in practices). However, mNutrition is a national-level programme based on an innovative public-private partnership rather than a small-scale pilot intervention (as most mobile phone-based advisory services currently are). A major shortcoming of most studies on the use of mobile phone-based advisory services in low-and middle-income countries is their poor methodological quality (as highlighted in literally all reviews cited above). The evaluation of the mNutrition programme addresses this major flaw. The data presented here is based on a large-scale rigorous mixed methods evaluation including an experimental quantitative design, in-depth longitudinal case studies with a variety of service users (including young and older mothers, and mothers from different socio-economic strata) and a business model analysis. This unique multi-pronged

approach allowed valuable and in-depth insights into the underlying causal processes of the mNutrition services and suggested many practical and actionable lessons of how remaining challenges in mobile phone-based advisory services can be addresses effectively.

8 Conclusions and lessons learned

The objectives of this mixed methods evaluation were to assess the impact, cost-effectiveness, and commercial viability of Wazazi Nipendeni, a mobile phone-based information service that aimed to promote behaviour change around key IYCF practices and behaviours, as well as around dietary diversity, that are likely to result in improved nutritional health within a household. This section summarises key findings and recommendations from this evaluation.

8.1 Effectiveness of Wazazi Nipendeni in reaching mothers and pregnant women

Wazazi Nipendeni achieved only a low reach; this can be explained by shortcomings in the available supportive infrastructure, very limited sharing of content, and issues in the implementation and design of the programme. The evaluation showed the risk that mobile phone-based services may also generate new inequalities, as very poor mothers who could not afford a phone or had limited/no access to a phone were often excluded from the service. In contexts in which people frequently manually switch between multiple SIM cards, tying a service to one specific SIM card is also problematic; this issue could be avoided by allowing users to access services using multiple SIM cards. However, it should also be highlighted that both mothers and fathers who successfully received Wazazi Nipendeni messages usually read the majority of the messages. This suggests that the messages themselves were not to blame for the low reach.

Supportive infrastructure is vital to ensure mobile phone-based information services reach the intended target group. This includes phone ownership, access to electricity, and also autonomy over access – especially for women. If these are not in place, alternative modes of content delivery (e.g. via radio or community outreach) or blended approaches (e.g. radio and community workers) may have a wider reach and be more inclusive. Interpersonal contact with people who are perceived as credible (e.g. health workers) is important to build initial trust in a mobile phone-based service, and can motivate mothers/their households to sign up.

Text messages can be an effective delivery modality for information in contexts with high levels of literacy and one commonly spoken language, as long as the target group successfully receives the messages. Content sharing could increase the reach of the service considerably, including to mothers who are currently excluded. This could be encouraged by sending reminders to share, and highlighting the wider benefits of sharing for the whole community.

8.2 Impacts of Wazazi Nipendeni on nutrition outcomes

Access to Wazazi Nipendeni had small positive impacts on IYCF knowledge among men and women (statistically significant only among men), and on dietary diversity among children and women. However, these positive impacts did not translate into an improvement in nutritional status among children. This limited impact can, in part, be explained by contextual barriers that prevented families from translating advice into real-world practices: most importantly, a lack of financial resources. Joining up the service with other ongoing interventions that help poor families to deal with poverty, such as social protection programmes, might increase impact.

Despite these disappointing findings, quantitative and qualitative data suggest that mothers/fathers who actively engaged with Wazazi Nipendeni made at least some changes in their IYCF and

caring practices, as well as the foods they ate themselves and /or served to their families. The types of changes made varied greatly and depended on the financial circumstances, capacities, and contexts of the households.

The many granular effects of the service on household behaviours also suggest the need for different methods to evaluate mobile phone-based interventions in future. Rigorous experimental designs could be complemented by more agile, short-term, and adaptive evaluation methods.

The evaluation findings also suggest that the service positively influenced both women's and men's use of mobile phones. Women, who often only had limited and closely monitored access to mobile phones in Iringa Region, were significantly more likely to have used mobile phones as a result of Wazazi Nipendeni. Services such as Wazazi Nipendeni might help to bridge the digital gender gap by convincing husbands of the benefits of allowing their wives to access mobile phones more freely in order to benefit the well-being of the family.

8.3 Process of content development for Wazazi Nipendeni

The subsample of mothers/fathers that used the service found the messages easy to understand, useful, and relevant. They appreciated the non-judgemental tone of the messages and the fact that the content was tailored towards the specific stage of their pregnancy or age of the child. This was especially true in areas with limited access to formal health and nutrition advice, in contexts with overcrowded health facilities in which health workers had little time to provide advice, and by individuals who were excluded from formal services due to work commitments or being unmarried.

Most users liked practical, context-specific advice that complemented the high-level advice that they received from other sources, such as government health workers. Content that recommended costly animal-sourced foods and fresh fruits was perceived as less relevant. Future interventions should focus on providing practical, low-cost, and context-specific advice that is realistic in resource-poor contexts, rather than mainly reinforcing existing generic knowledge.

While mobile phone-based messages might be an effective mode of delivery for information on IYCF practices, they cannot help users to develop the skills to practise them. For example, women usually need more intensive and interpersonal support in learning optimal breastfeeding practices. Wazazi Nipendeni messages could be strengthened by actively encouraging mothers to visit health workers for support in developing these skills.

Mothers look for information to tackle individual, acute nutritional and health problems; introducing two-way communication channels such as call centres or interactive dialogues could help them get the information they need at the time they need it. Message content needs to be updated regularly to remain relevant, reliable, and useful, so this needs to be factored into the programme planning and funding.

Messages that are tailored towards each stage of pregnancy and early childhood can inadvertently raise suspicion in contexts in which pregnancy and early childhood are perceived as private family issues. Badly timed messages risk disengagement with the service. Individualised profiling and detailed explanation of the service during registration is vital to build trust and ensure continued engagement.

8.4 Mobile phone-based services for behaviour change

A range of factors give mobile phones an advantage over ‘traditional’ channels for behaviour change communication. The tailoring of messages described above, the frequency of messages, the privacy that is afforded by personal messages, and the fact that they can be read at any time are all important for mothers, who struggle with multiple demands on their time. In a context of overcrowded and understaffed public healthcare services, mobile phone-based information services can offer a low-cost mechanism for reaching parents.

However, the Wazazi Nipendeni service had various shortcomings that limited its effectiveness for behaviour change. Social support has been shown to be critical in behaviour change interventions, especially for breastfeeding and other IYCF practices. Introducing interactive components into mobile phone-based services, such as a call centre or other forms of human support, is likely to significantly increase their effectiveness in changing behaviours. Mobile phone-based advisory services such as Wazazi Nipendeni are unlikely to be effective as a stand-alone channel for behaviour change: they should be one part of a many-pronged policy, and not the only component aiming to change behaviours and practices.

Finally, trust and credibility is vital. Mobile phone-based information from a source that is perceived as credible can help to enhance mothers’ bargaining power in intra-household spending negotiations, by convincing fathers to take more responsibility in regard to childcare-related activities.

8.5 Commercial viability of business models for Wazazi Nipendeni

The ability to broker a complex set of partnerships with a diverse range of stakeholder groups has been crucial to the successful operation of the service: these partnerships have been successful due, at least in part, to the personal skills and commitment of the mHealth Tanzania-PPP team. Field partners play a crucial role in providing a face-to-face presence that supports users by getting them registered, reinforcing messages, and enhancing the effectiveness of the service. Investment, partnerships, and political commitment need to be developed in order to implement an information dissemination programme at national scale – this needs to be recognised by donors.

The Wazazi Nipendeni service yields substantial indirect benefits to mobile operators in terms of increased ARPU. The effect size was at least a 10% increase in ARPU (510 TZS/month), and is likely to be higher still, possibly as a result of women becoming more confident in their use of phones.

MNOs provide zero-rated SMS as part of their corporate social responsibility, and yet they are getting an indirect benefit that gives them revenue that exceeds their ‘donation’, even when that donation is assigned a retail SMS value. This makes it critical to identify a mechanism whereby content created using public funds can be paid for through some form of revenue share of the financial benefit yielded by the services.

Despite the vulnerabilities in the current business model in regard to continued funding from CDC, and free SMS messages continuing to be donated by MNOs, the model articulated by the mHealth Tanzania-PPP appears to be sustainable. The mHealth Tanzania-PPP continues to enter into agreements with new public health programmes, recent policy documents suggest that continued donor funding is likely to be forthcoming, and negotiations with CDC for renewed donor funding are at an advanced stage. There may be merit, therefore, in the donor-funded business model.

Emerging mHealth services exploit the potential of the internet, of smartphones, of data acquisition and analysis, and of mobile money services. This is consistent with trends in the telecoms market of growth in data and mobile money. mHealth services will need to be agile as they incorporate emerging technologies into their service offering.

8.6 Conclusions

Mobile phone-based services are not a magic bullet, but they are valued by users who engage with the service, so could be a valuable addition to programmes aimed at improving nutrition and agriculture-related knowledge and changing behaviour. Mobile phone-based advisory services alone tend not to be enough to affect agricultural and nutrition outcomes, which generally have complex determinants. Human interactions are vital to support, facilitate and ensure sustained engagement with the service.

Mobile phone-based services to change behaviour are likely to be most effective if embedded in trusted structures (such as agriculture extension services), if they are linked up with other programmes that address underlying barriers to change (such as social protection programmes) and paired with established low-tech, inclusive approaches (such as radio).

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Annex A List of all study outputs

Publication title	Type	IDS website link
IDS Working Paper 481: Dial 'N' for Nutrition? A Landscape Analysis of What We Know About m-Nutrition, m-Agriculture and m-Development	Technical report	www.ids.ac.uk/publications/dial-n-for-nutrition-a-landscape-analysis-of-what-we-know-about-m-nutrition-m-agriculture-and-m-development/
Desk review: Smallholder farming, nutrition and m-Agriculture services in Ghana	Technical report	www.ids.ac.uk/publications/desk-review-smallholder-farming-nutrition-and-m-agriculture-services-in-ghana/
Desk review: Determinants of undernutrition and existing mHealth services in Tanzania	Technical report	www.ids.ac.uk/publications/desk-review-determinants-of-undernutrition-and-existing-m-health-services-in-tanzania/
Inception report: External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia	Technical report	www.ids.ac.uk/publications/inception-report-external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-and-south-asia/
Research methodology brief: Using quantitative methods to evaluate mobile phone technology-based nutrition and agriculture advisory services in Ghana	Briefing	www.ids.ac.uk/publications/using-quantitative-methods-to-evaluate-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-ghana/
Research methodology brief: Using quantitative methods to evaluate mobile phone technology-based nutrition and agriculture advisory services in Tanzania	Briefing	www.ids.ac.uk/publications/using-quantitative-methods-to-evaluate-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-tanzania/
Research methodology brief: Using qualitative methods to evaluate mobile phone technology-based nutrition and agriculture advisory services in Ghana and Tanzania	Briefing	www.ids.ac.uk/publications/using-qualitative-methods-to-evaluate-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-tanzania-and-ghana/
Research methodology brief: Using a business model and cost-effectiveness analysis to evaluate mobile phone technology-based nutrition and agriculture advisory services in Tanzania and Ghana	Briefing	www.ids.ac.uk/publications/using-a-business-model-and-cost-effectiveness-analysis-to-evaluate-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-tanzania-and-ghana/

Publication title	Type	IDS website link
Mobile phones, nutrition and agriculture in Ghana: Initial exploratory qualitative study report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-agriculture-in-ghana-initial-exploratory-qualitative-study-report-external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-afr-2/
Mobile phones, nutrition and health in Tanzania: Initial exploratory qualitative study report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-health-in-tanzania-initial-exploratory-qualitative-study-report-external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-afric-2/
Mobile phones, nutrition, and agriculture in Ghana: Cost-effectiveness baseline report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-agriculture-in-ghana-cost-effectiveness-baseline-report/
Mobile phones, nutrition and agriculture in Ghana: Business modelling baseline report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-agriculture-in-ghana-business-modelling-baseline-report/
Mobile phones, nutrition and health in Tanzania: Cost-effectiveness baseline report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-health-in-tanzania-cost-effectiveness-baseline-report/
Mobile phones, nutrition and agriculture in Tanzania: Business modelling baseline report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-agriculture-in-tanzania-business-modelling-baseline-report/
Mobile phones, nutrition, and agriculture in Ghana: Quantitative baseline report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-agriculture-in-ghana-quantitative-baseline-report/
Mobile phones, nutrition, and health in Tanzania: Quantitative baseline report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutritionand-health-in-tanzania-quantitative-baseline-report/
Ghana mixed methods baseline report	Technical report	www.ids.ac.uk/publications/ghana-mixed-methods-baseline-report-external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-and-south-asia/
Ghana mixed methods baseline report – Executive summary	Summary paper	www.ids.ac.uk/publications/the-ghana-mixed-methods-baseline-report/

Publication title	Type	IDS website link
Tanzania mixed methods baseline report	Technical report	www.ids.ac.uk/publications/tanzania-mixed-methods-baseline-report-external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-and-south-asia/
Tanzania mixed methods baseline report – Executive summary	Summary paper	www.ids.ac.uk/publications/the-tanzania-mixed-methods-baseline-report/
Mobile phones, nutrition and health in Tanzania: Qualitative midline study report	Technical report	www.ids.ac.uk/publications/mobile-phones-nutrition-and-health-in-tanzania-qualitative-midline-study-report-external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-and-south/
Mobile phones, agriculture, and nutrition in Ghana: Qualitative midline study report	Technical report	www.ids.ac.uk/publications/mobile-phones-agriculture-and-nutrition-in-ghana-qualitative-midline-study-report/
Lessons learned brief for Ghana and Tanzania	Summary paper	www.ids.ac.uk/publications/lessons-learned-brief-for-ghana-and-tanzania/
Mobile phones, agriculture, and nutrition in Ghana: Qualitative follow-up study report	Technical report	www.ids.ac.uk/publications/external-evaluation-of-mobile-phone-technology-based-nutrition-and-agriculture-advisory-services-in-africa-mobile-phones-agriculture-and-nutrition-in-ghana-qualitative-follow-up-study-report/
Mobile phones, health and nutrition in Tanzania: Qualitative follow-up study report	Technical report	Available on IDS website shortly
Mobile phones, nutrition, and agriculture in Ghana: Quantitative Endline Report	Technical report	Available on IDS website shortly
Mobile phones, nutrition, and health in Tanzania: Quantitative Endline Report	Technical report	Available on IDS website shortly
Mobile phones, nutrition, and agriculture in Ghana: Cost-Effectiveness Endline Report	Technical report	Available on IDS website shortly
Mobile phones, nutrition and agriculture in Ghana: Business Modelling Endline Report	Technical report	Available on IDS website shortly
Mobile phones, nutrition and health in Tanzania: Cost-effectiveness Endline Report	Technical report	Available on IDS website shortly
Mobile phones, nutrition and agriculture in Tanzania: Business Modelling Endline Report	Technical report	Available on IDS website shortly
Mobile phones, nutrition and health in Tanzania: Final mixed methods evaluation report	Technical report	Available on IDS website shortly
Mobile phones, nutrition and health in Ghana: Final mixed methods evaluation report	Technical report	Available on IDS website shortly

