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Designing a Mixed-Method Impact Evaluation for a Mobile Phone Application for Nutrition Service Delivery in Indonesia

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June 2014

The IDS programme on Strengthening Evidence-based Policy works across seven key themes. Each theme works with partner institutions to co-construct policy-relevant knowledge and engage in policy-influencing processes. This material has been developed under the Reducing Hunger and Undernutrition theme.

Transform Nutrition is a DFID-funded consortium of six international research and development partners. Using research-based evidence we aim to inspire effective action to address undernutrition (www.transform-nutrition.org).

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DESIGNING A MIXED-METHOD IMPACT EVALUATION FOR A MOBILE PHONE APPLICATION FOR NUTRITION SERVICE DELIVERY IN INDONESIA

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Executive summary

Introduction

Child undernutrition remains one of the most devastating realities in many parts of the world. The use of mobile phone technology may offer innovative opportunities to tackle persistently high levels of child undernutrition. Despite the enthusiasm for using mobile phones for nutrition service delivery, a recent review found very few studies that critically assessed their application. A major shortcoming of the existing studies was that they were all based on small one-off pilot projects and integration into national nutrition strategies or programmes was minimal or non-existent. As a result of this lack of integration, the sustainability of mobile phone-based nutrition systems was generally low and most projects ceased to exist after the pilot.

Together with World Vision Indonesia and World Vision Canada, we aim to address this evidence gap. We set out to rigorously evaluate the piloting of a mobile phone application for nutrition service delivery, including community-based growth monitoring and nutrition counselling.

The mobile phone application will be integrated into the existing national nutrition service delivery through the posyandu programme. Posyandus (short for *pos pelayanan terpadu*, which translates as 'integrated health service post') are monthly service posts at sub-village level that form the lowest level of the primary health care infrastructure in Indonesia.

This report presents the evaluation design and documents the process of choosing and developing an appropriate evaluation approach within the given contextual setting. With the aim of developing a context-specific evaluation design that would allow us to best address the evaluation objectives, we reviewed and discussed the different evaluation approaches available.

Objectives of the evaluation

The key objectives of the evaluation are:

1. To examine the impact of the mobile phone application on growth-monitoring activities. The specific objectives are:
    a. To assess the impact on data accuracy and timeliness.
    b. To explore the impact on real-time responsiveness during the monthly posyandu.
    c. To explore the effect on responsiveness by the government and other stakeholders.
2. To assess the impact of the mobile phone application on the quality of nutrition counselling.

This evaluation also aims to generate learning about the contextual conditions under which the mobile phone application brings about the desired improvements and why. This will help to inform further development of the programme and the potential transfer of the mobile phone application to other settings in Indonesia and globally.

Evaluation design and approaches

The choice of evaluation approaches needs to be determined by the evaluation objectives, the contextual factors of the posyandus, the characteristics of the mobile phone intervention and an analysis of the problems and threats of growth monitoring and nutrition counselling

that the mobile phone application is meant to address (Hansen 2005). The evaluation team conducted a qualitative scoping visit to the pilot sites in Indonesia and reviewed and compared alternative evaluation approaches, in order to identify, tailor and combine the most appropriate ones to address the stated evaluation objectives.

Assessment of data accuracy and timeliness

Two context-specific challenges/opportunities that influenced the choice of the evaluation design were:

1. The 14 study posyandus for this evaluation had already been selected by the World Vision team prior to the evaluation and could not be changed.
2. It is currently impossible to replace the paper-based growth monitoring in the posyandus with mobile phone-based growth monitoring due to the statutory reporting obligations of the posyandus to local and district level health offices and other stakeholders. Consequently, the mobile phone application needs to be introduced in parallel to the existing paper-based growth monitoring in the posyandu.

As a result, it was impossible to use common causal inference models for impact evaluation, including randomised controlled trials (RCTs), quasi-experiments and natural experiments. However, the unique setting offered the opportunity to use a counterfactual design based on the same causal inference logic: Mill's Method of Difference. This causal inference design is not normally identified as an experiment as there are no treatment and control groups: the same group receives both – the treatment and no treatment – and produces separate outcomes following each of these simultaneous processes. Using this approach, it will be possible to robustly assess the impact of the mobile phone application on both data accuracy and data timeliness.

Assessment of real-time responsiveness in the posyandu

To examine the underlying mechanisms that may lead to real-time responsiveness and identify what works, how, for whom and under what circumstances, a realist evaluation approach will also be employed in addition to the comparative causal inference design based on Mill's Method of Difference (Mill 1843).

Assessment of responsiveness by governments and other stakeholders

Growth-monitoring data collected in the posyandu using the mobile phone application may be more credible and timely than the traditional paper-based data collection. This may persuade decision makers to trust and increase the use of growth-monitoring data to inform nutrition-related decision-making, track undernutrition and respond to nutritional crises. As this study will be conducted in only 14 treatment posyandus (i.e. it will not be representative at sub-district or district level) and over a period of just 12 months, it is impossible to assess whether mobile phone-based nutrition data will bring about systemic changes in the government's and other stakeholders' behaviour. However, it will be possible to identify contextual factors and conditions that may act as levers and facilitate or hinder uptake and effective use of mobile phone-based data. A political economy analysis of nutrition-related decision-making processes with stakeholder interviews will be conducted to learn more about how nutrition-related decisions are made and what role mobile phone-based data could play to increase responsiveness in the long-term.

Assessment of quality of nutrition counselling

The evaluation of the impact of the mobile phone application on nutrition counselling will focus on the three steps of home-based nutrition counselling: (i) the initial assessment of current feeding practices; (ii) the analysis of the initial information and identification of challenges; and (iii) the provision of tailored behaviour-change messages to the caregiver.

To ‘unwrap’ the causal mechanisms that link the use of mobile phone technology and the quality of home-based counselling, a process-tracing evaluation approach will be used.

Formative evaluation phase

The evaluation also includes a formative phase that aims to (1) test the functioning of the mobile phone application; (2) assess the acceptability of the mobile application by the cadres, caregivers and other community members; and (3) examine the feasibility of the different data collection methods proposed for the different evaluation approaches chosen.

Conclusions

The study sets out to conduct a scientifically robust evaluation of the impact of a mobile phone application on growth monitoring and nutrition counselling in posyandus in rural and urban Indonesia. In contrast to the small number of existing studies, the mobile phone application will be integrated into the existing national system for nutrition service delivery in Indonesia. Hence the evaluation team needed to choose the evaluation design and approaches based on careful analysis of contextual factors and considerations. The resulting design draws on several innovative approaches to rigorously evaluate the impact of mobile phone technology on the accuracy and timeliness of, and real-time responsiveness to, growth monitoring and the quality of nutrition counselling.

1 Introduction

Undernutrition remains one of the most devastating realities in many parts of the world. Undernutrition in early childhood can impair growth and cognitive development, with lifelong consequences for health, economic and physical wellbeing (Victora *et al.* 2008; Black *et al.* 2013).

The use of mobile phone technology offers innovative opportunities to tackle persistently high levels of child undernutrition in many parts of the world. 'M-nutrition', or the application of mobile phone technology to improve access, quality, timeliness and lower costs of nutrition services delivery, is becoming increasingly popular with international agencies and non-governmental organisations, as well as national and local-level organisations and institutions (World Health Organisation 2011). Mobile phones have been employed to facilitate nutrition surveillance and community-based growth monitoring (Berg, Wariero and Modi 2009; Blaschke *et al.* 2009), nutrition behaviour change communication and promotion (Lee *et al.* 2006; Cole-Lewis and Kershaw 2010; Déglise, Suggs and Odermatt 2012) and management of nutrition-related diseases (Berg *et al.* 2009; Cole-Lewis and Kershaw *op. cit*.; Dacso and Knightly 2011). Available technology options range from the application of simple handsets and short message services (SMS) to sophisticated smart phone applications with audio-and video recordings on behavioural change and disease management.

Despite the enthusiasm about m-nutrition, a recent review found very few studies that critically assessed the application of mobile phone technology for nutrition in resource-poor settings (Barnett and Gallegos 2013). The evidence that was gathered focused mainly on the documentation of technical features of mobile phone-based systems and was based on small one-off pilot-projects. Integration into national nutrition strategies or programmes was minimal or non-existent and sustainability and potential for scale-up was low, with most projects ceasing to exist once donor support ran out.

Together with World Vision Indonesia and World Vision Canada (hereafter referred to as World Vision), we aim to address this evidence gap on the impact and sustainability of mobile phone technology. We set out to rigorously evaluate the piloting of a mobile phone application for nutrition service delivery, including community-based growth monitoring and nutrition counselling. For this study, the mobile phone application will be integrated into nutrition service delivery at community level through Indonesia's *posyandu* system for a pilot period of 12 months. The posyandu is a monthly health clinic at sub-village level that forms the lowest level of the primary health care infrastructure in Indonesia (World Vision 2013).

The key objectives of the evaluation are:

1. To examine the impact of the mobile phone application on growth-monitoring activities, specifically:
    a. To assess the impact on data accuracy and timeliness.
    b. To explore the impact on real-time responsiveness during the monthly posyandu.
    c. To explore the effect on responsiveness by the government and other stakeholders.
2. To assess the impact of the mobile phone application on the quality of nutrition counselling.

This evaluation also aims to generate insights into contextual conditions under which the mobile phone application brings about the desired improvements, and why. This will help to inform the further development of the programme and potential transfer of the mobile phone application to other settings in Indonesia and globally.

This report presents the evaluation design and documents the process of choosing and developing an appropriate evaluation approach within the given contextual setting. With the aim of developing a context-specific evaluation design that would allow us to best address the evaluation objectives, we reviewed and discussed the different evaluation approaches available. We also conducted an initial qualitative scoping visit to the pilot sites in Indonesia in February 2014. The report starts with a brief background section on Indonesia, with a specific focus on the nutrition situation and nutrition service delivery through the posyandu system. In Section 3, the mobile phone intervention in the posyandu and the Theory of Change of the intervention are outlined. Section 4 presents an overview of the evaluation design, the approaches and study site selection. Detailed descriptions of each evaluation component (formative evaluation; growth monitoring and nutrition counselling) will be presented in Sections 5, 6 and 7 respectively. These are followed by a brief outline of the different data collection tools, analysis plans and ethical considerations in Section 8. The report is completed by a brief outline of an additional cost-benefit analysis and its challenges in Section 9, a discussion of the strengths and limitations of the methodology in Section 10; we present our conclusions in Section 11.

2 Background

2.1 Geography, demography and administrative system of Indonesia

Indonesia is the largest archipelago in the world, with more than 17,000 islands (CIA 2014). Its population is approaching 254 million; the vast majority live on one of the five major islands - Java, Kalimantan, Papua, Sulawesi and Sumatra, see Figure 2.1 below (CIA 2014).

Figure 2.1 Map of Indonesia

Source: CIA (2014).

Indonesia has a rich cultural diversity, with more than 300 ethnic groups, each with its own language, history and traditions. While 87 per cent of the population are Muslims, Indonesia actively promotes religious freedom with 8 per cent of the population being Christian, 3 per cent Hindu, and 2 per cent Buddhist or others (CIA 2014). The national motto and the basis of religious, cultural and social freedom is: 'Unity in Diversity' (*Bhinneka Tunggal Ika*).

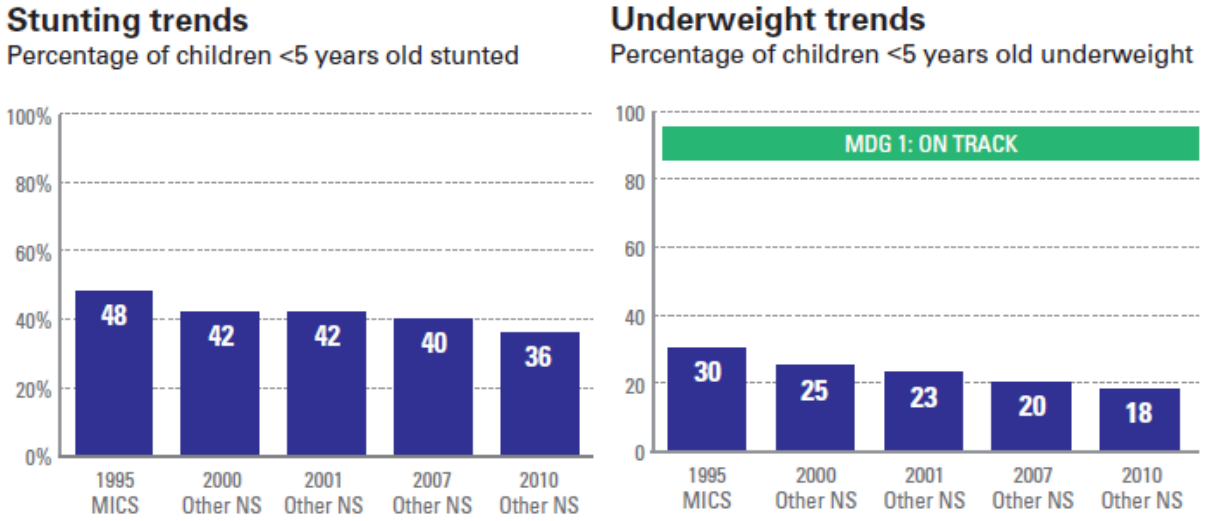
Indonesia is divided into 33 administrative provinces, which are subdivided into regencies and cities, which are further subdivided into 399 districts, 6,793 sub-districts and again into 79,075 villages (CIA *op. cit*.). In 1999 Indonesia began a process of extensive decentralisation from a previously strictly centralised governance structure. As part of this process, health care provision, including the responsibility for the planning, budgeting and management of nutrition services, was devolved to district-level governments (Chongsuvivatwong *et al.* 2011; McDonald and Yoganingrum 2011). The rationale behind the decentralisation was to enable local authorities to identify, respond and address local nutrition challenges using creative and innovative context-specific approaches and local knowledge (UNICEF 2012). The impact of the decentralisation with regards to access to, and quality of, nutrition service delivery has been mixed and is well-documented in the literature (see, for example, Guess 2005; Kristiansen and Santoso 2006; World Bank *et al.* 2006; Pal and Wahhaj 2012; Prasetyia 2012; Susilo 2012; Flynn 2014). To gain deeper insights into the challenges and opportunities of district-level nutrition service delivery and to assess the potential for scale-up of the mobile phone application to other districts, a comprehensive review of this literature is planned as part of the evaluation.[1]

[1] See Section 6.3.

2.2 Child nutrition in Indonesia

Since 1995, levels of child undernutrition, both low height-for-age (stunting) and low weight-for-height (wasting), have declined considerably thanks to improved community-based nutrition and health services and effective health policy regulations - see Figure 2.2 (World Bank *et al. op. cit*.).

Figure 2.2 Trend in prevalence of stunting and wasting among under-fives in Indonesia, 1995-2010



Source: UNICEF (2013b).

However, while the proportion of stunted and wasted children has declined, the absolute number of undernourished children in Indonesia remains one of the highest in the world. With more than 7.5 million stunted (see Figure 2.3) and 2.8 million wasted (no figure provided), children below the age of five years, Indonesia is globally ranked fifth and fourth respectively for these measures (UNICEF 2013b).

Figure 2.3 Global burden of stunting (countries with the largest absolute number of children below the age of five years who are moderately or severely stunted)

Ranking	Country	Year	Stunting prevalence (%)	% of global burden (2011)	Number of stunted children (moderate or severe, thousands)
1	**India**	2005–2006	48	38	61,723
2	**Nigeria**	2008	41	7	11,049
3	**Pakistan**	2011	44	6	9,663
4	**China**	2010	10	5	8,059
5	**Indonesia**	2010	36	5	7,547
6	**Bangladesh**	2011	41	4	5,958
7	**Ethiopia**	2011	44	3	5,291
8	**Democratic Republic of the Congo**	2010	43	3	5,228
9	**Philippines**	2008	32	2	3,602
10	**United Republic of Tanzania**	2010	42	2	3,475
11	Egypt	2008	29	2	2,628
12	Kenya	2008–2009	35	1	2,403
13	Uganda	2011	33	1	2,219
14	Sudan	2010	35	1	1,744

Note: The countries in bold are profiled beginning on page 55 of this report. Updated data from Afghanistan and Yemen were not available, but these countries are likely to contribute significantly to the global burden of stunting – last reported data of stunting prevalence were 59 per cent for Afghanistan in 2004 and 58 per cent for Yemen in 2003.

Source: UNICEF Global Nutrition Database, 2012, based on MICS, DHS and other national surveys, 2007–2011, except for India.

Source: UNICEF (2013b).

There are also considerable inequalities in the distribution of child undernutrition, with children growing up in rural areas and in households in the lowest wealth quintiles being most affected (Figure 2.4).

Figure 2.4 Disparities in the distribution of child undernutrition in Indonesia, 2010

Indicator	Gender			Residence			Wealth quintile							Source
	Male	Female	Ratio of male to female	Urban	Rural	Ratio of urban to rural	Poorest	Second	Middle	Fourth	Richest	Ratio of richest to poorest	Equity chart	
Stunting prevalence (%)	37	34	1.1	31	40	0.8	43	39	34	31	24	0.6		Other NS, 2010
Underweight prevalence (%)	19	17	1.1	15	21	0.7	23	19	18	15	10	0.5		Other NS, 2010
Wasting prevalence (%)	14	13	1.1	13	14	0.9	15	14	13	12	11	0.7		Other NS, 2010

Source: UNICEF (2013b).

Obesity and overweight are also fast-emerging issues in childhood in Indonesia, with one in seven children under the age of five being overweight in 2012 (UNICEF 2013b). This constitutes an absolute number of 3 million children (UNICEF 2012). Overweight is most prevalent in urban areas, although obesity in rural areas is rising rapidly. Childhood obesity has been shown to increase the risk for early onset of type 2 diabetes, metabolic syndrome, cardiovascular diseases and adulthood obesity (Gupta *et al.* 2012; Roemling and Qaim 2012).

2.3 The Indonesian health system and the posyandus

2.3.1 The Indonesian health system

As described above, Indonesia has a decentralised health care system, with most of the health care planning, information systems and funding controlled by the regional governments. Total spending for health has increased in recent years, but was still only 2.7 per cent of GDP in 2011, far below the OECD average of 9.3 per cent (OECD 2013). Table 2.1 presents the different levels of health care in Indonesia, starting with the central Ministry of Health in Jakarta and the provincial health offices, down to the posyandus at sub-village level.

Table 2.1 Primary health infrastructure in Indonesia

Level	Institution	Number
Central	Ministry of Health	1*
Province (34)	Provincial Health Office	34*
Districts (511)	District Health Office	511*
Sub-district (6,879)*	Health Centre	9,422**
	Without in-patient care	3,061**
	With in-patient care	6,361**
	Sub-health centre	23,525**
Village (79,702)*	Village health post	42,233**
Sub-village	Integrated service post (Posyandu)	266,827**

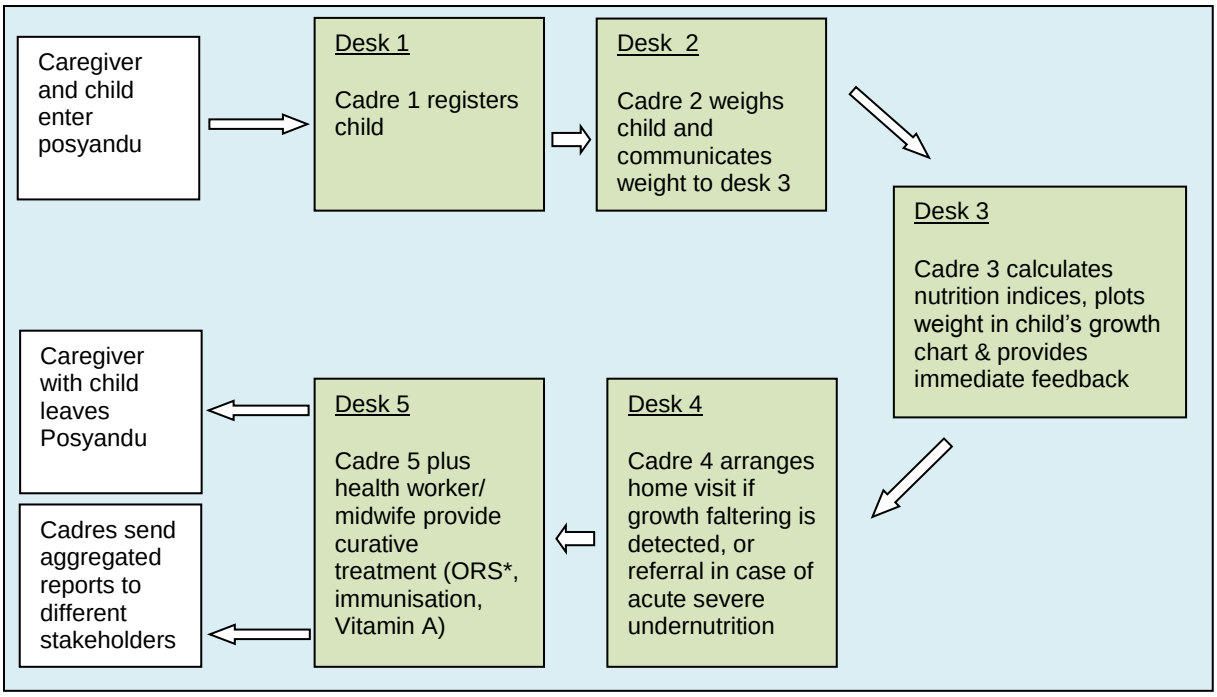
*Statistics Indonesia (2012)
**Ministry of Health (2012)
Source: adapted from World Vision (2013).

2.3.2 The posyandu programme

The posyandu programme in Indonesia was started in 1986 and is supported by the district health offices (via funding from the Ministry of Health), the Ministry of Internal Affairs and the Family Empowerment and Welfare (FEW).[2] Posyandus provide services related to five major programmes including family planning, mother and child health, nutrition (growth monitoring, nutrition counselling, vitamin and mineral supplementation), immunisation and diarrhoea disease control (World Vision 2013). Posyandus are run by five (and in some cases more) local community volunteers (cadres) and are usually conducted on a monthly basis at a central place (usually in a house provided by the community) in both urban and rural communities. One posyandu serves between 50 and 100 children below the age of five years (in urban areas the number of children is usually higher and can reach 100; in rural areas approximately 50 children attend the posyandu sessions).

This pilot and evaluation study will focus on the nutrition service delivery as part of the monthly posyandu session. Monthly growth monitoring and nutrition counselling follows a specific procedure with five successive tasks. Each task is performed by one cadre at one of five desks (also called stations). All growth-monitoring and nutrition-counselling activities are based on paper-based systems (e.g. registration books, reports, growth charts). Data collected as part of the growth-monitoring activities are aggregated by the cadres and compiled into different reports that are sent to district-level health authorities, the local midwife and other relevant stakeholders. Figure 2.5 below describes the different tasks the cadres perform.

Figure 2.5 Growth monitoring and nutrition counselling procedure in the posyandu



*ORS – oral rehydration salts
Source: Authors' own.

[2] Government-led welfare movement.

2.3.3 Current challenges for nutrition service delivery in the posyandu

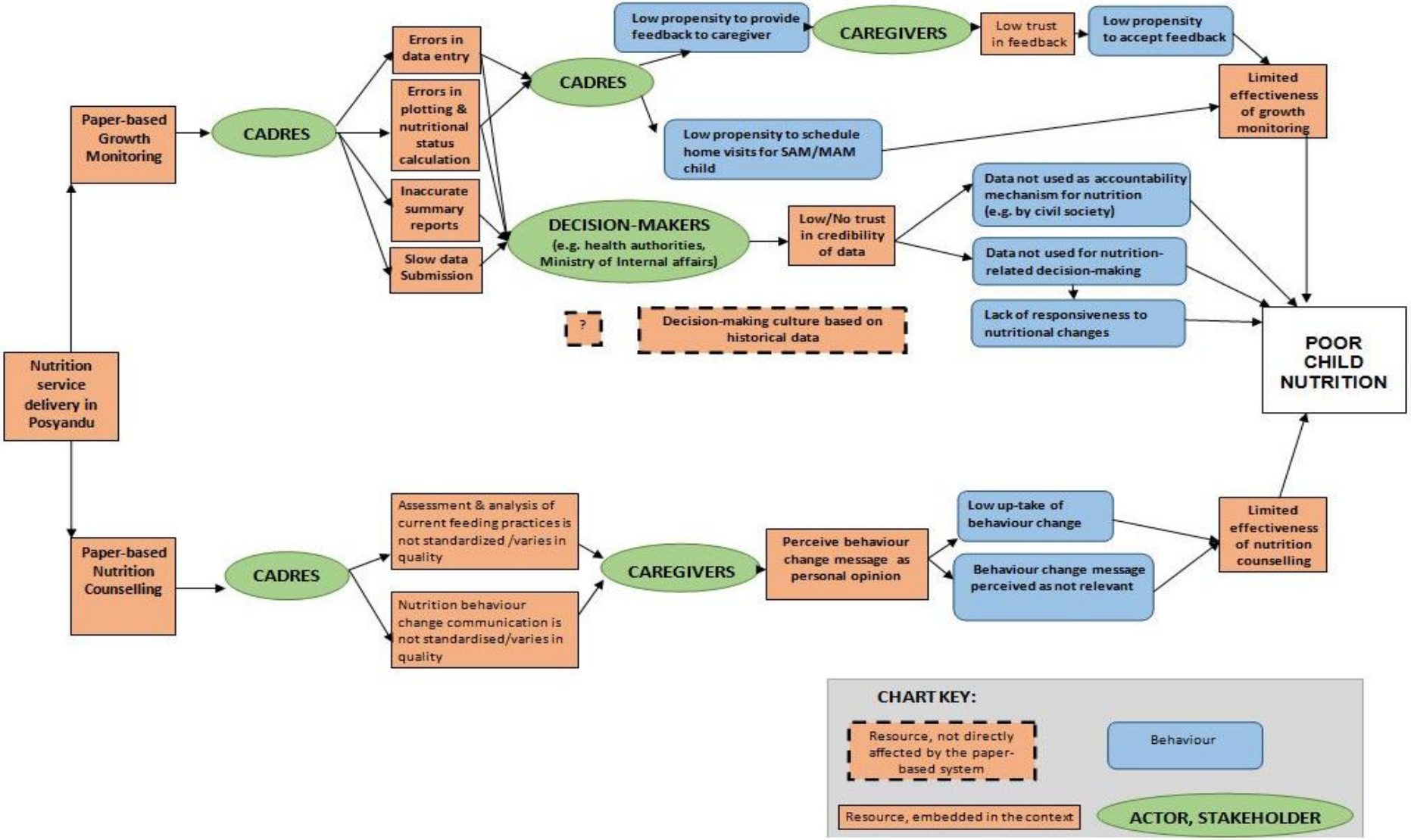
The posyandus face several challenges that may compromise growth-monitoring and nutrition-counselling activities. High drop-out rates among the cadres (especially after the political decentralisation and the discontinuation of the incentive schemes for the cadres in many districts), overcrowding and low funding for the posyandu activities, including lack of budget for equipment, are likely to affect both growth monitoring and nutrition counselling (Februhartanty 2005).

With regard to growth monitoring, concerns about low data accuracy and delays in data submission are a major concern and might pose an important barrier to the effective use of the data to inform decision-making (e.g. resource allocation), both at the local community level and also for higher-level health authorities (Rohde 1993; Mahmudiono 2007; World Vision 2013). It has been suggested that resource allocation to the posyandu is often based on historical data (e.g. data from the last nation-level nutrition survey), and the ability to respond rapidly to changes in nutritional status (e.g. during a natural disaster) is low as a result (Abdullah *et al.* 2012; World Vision 2013).

With regard to nutrition counselling, lack of training and the absence of standardised training materials has been shown to reduce its quality and effectiveness (World Bank *et al.* 2006; Ohtsuka and Ulijaszek 2007; World Vision 2013).

Figure 2.6 depicts the current challenges and their effects on the growth monitoring and nutrition counselling in the posyandus. They are presented in the form of a Theory of Change (ToC) even though in this version it is closer to a Theory of (no) Change.

Figure 2.6 Theory of (no) change of nutrition service delivery in posyandu



Source: Authors' own.

3 The mobile phone intervention in the posyandus

3.1 The MOTECH mobile phone application for nutrition service delivery

World Vision, together with technical support from the MOTECH Suite,[3] has designed a mobile phone-based application to facilitate nutrition service delivery in the posyandu. The MOTECH suite uses smart phones with an Android platform to facilitate both growth monitoring and nutrition counselling in the posyandu.

For the growth monitoring, the application can be used to register the child, collect anthropometric measurements, calculate z-scores (weight-for-age, weight-for-height, height-for-age) and to classify a child's nutritional status (underweight, overweight, wasting, stunting) and growth velocities. The application is also capable of generating summary reports from the data, aggregating single records according to different criteria (e.g. percentage of underweight children, growth trends and average weight for single children, etc.). The completed growth monitoring form for each child will be saved on the mobile phone and submitted via general packet radio service (GPRS) to the cloud-based, password-protected server.

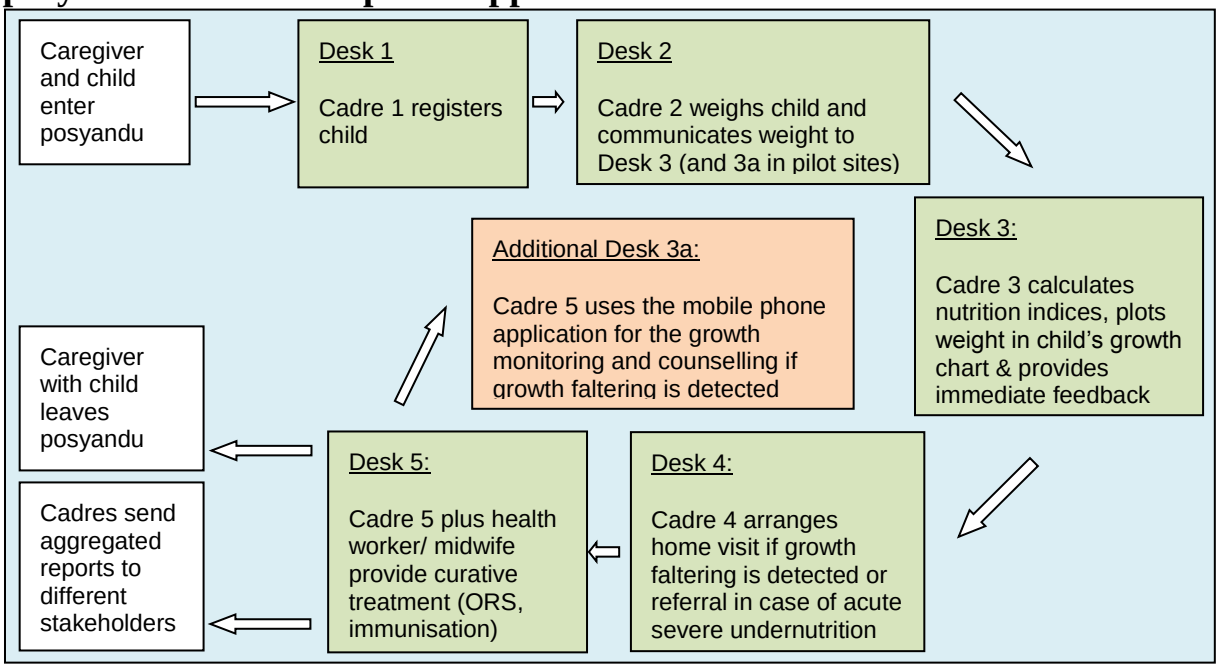
For the nutritional counselling, the application can be used to assess underlying illness and the current feeding practices of a child during the home-based counselling session, analyse this initial information to identify potential challenges and provide tailored nutrition messages based on the analysis.

3.2 Integration of the mobile phone application into nutrition service delivery in the posyandu

Figure 2.4 above (see Section 2.3.2) describes the current procedures of nutrition service delivery in the posyandus and the successive activities of the five cadres. The mobile phone application may facilitate and improve both the growth monitoring and nutrition counselling. Each posyandu included in the 12-month pilot study will receive one to two mobile phones. To avoid drastic changes in the traditional paper-based growth-monitoring and counselling activities and minimise the burden for the cadres (e.g. if the same cadre needs to collect growth-monitoring data using both the paper-based and mobile phone based system), the evaluation team will move Cadre 5 to a newly established Desk 3a for this pilot study. This is possible as Desk 5 is staffed by a cadre and a health worker/midwife. Cadre 5 will be responsible for the mobile phone and will conduct the growth monitoring and nutrition-counselling activities on the phone. Figure 3.1 describes the process. Several cadres in each posyandu will be trained to use the mobile phone application and will alternate in using the mobile phone during the posyandus.

[3] World Vision has been collaborating with the Bill and Melinda Gates Foundation, Grameen Foundation, and Dimagi in a public-private partnership arrangement to deploy a global, scalable mobile health solution (Motech Suite) to support various health and nutrition programming approaches.

Figure 3.1 Growth-monitoring and nutrition-counselling procedure in the posyandu with mobile phone application



Source: Authors' own.

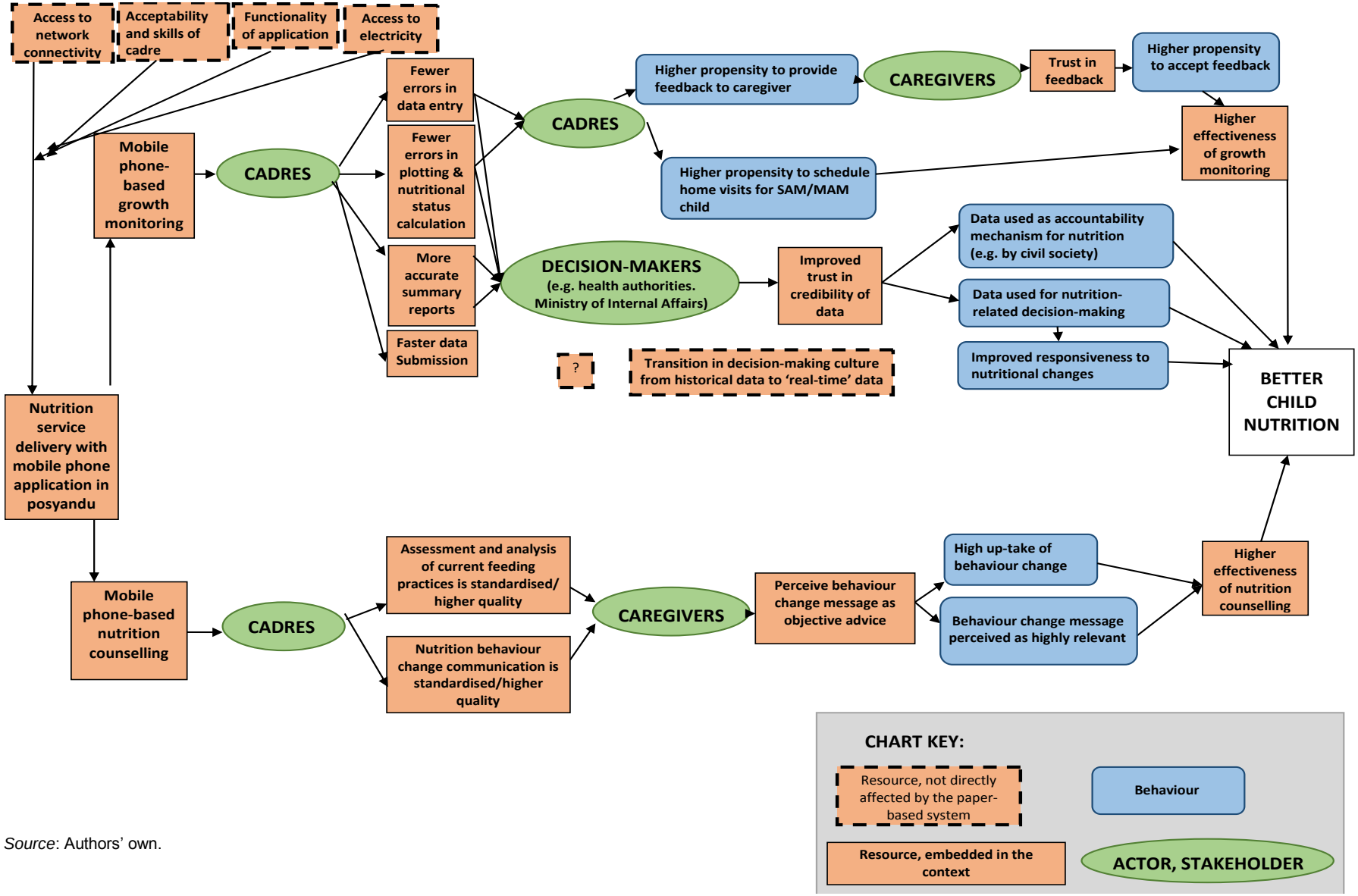
3.3 The Theory of Change (ToC)

The Theory of Change aims to map out the nuts and bolts of the intervention activities, accompanied by the required conditions for success in the short and long term and the drivers, barriers and risks/threats (Kubisch *et al.* 1995; Blamey and Mackenzie 2007). The theory of change (illustrated in Figure 2.6) informs the generation of specific evaluation questions and aids the selection of meaningful evaluation indicators to track progress and examine whether or not the desirable outcomes are being achieved. Finally, the theory of change facilitates the analysis and interpretation of why the mobile phone technology improved or failed to improve nutrition service delivery in the pilot posyandus. For instance, the evaluation may conclude that the mobile technology failed to improve nutrition counselling; however, this may be due to incorrect implementation (e.g. cadres refused to use technology, problems with technology), also called 'implementation failure'; or it may be due to the poor quality of the programme theory (e.g. the theory is illogical, has weak support in the literature and according to the views of stakeholders, the mechanisms require conditions that are not met in the specific context), which is also called 'programme theory failure' (Suchman 1969; Weiss 1997; Stame 2010; Funnell and Rogers 2011).

The Theory of Change was refined in a collective and iterative process by the IDS/World Vision evaluation team during the initial qualitative scoping visit to the pilot sites, with the contribution of a wide range of stakeholders, including programme implementers at the field level, cadres and mothers. The basic notions behind the theory of change are that the mobile technology produces resources (improved timeliness, accuracy, etc.) that may affect the actions and behaviours of stakeholders.

The evaluation team is aware of the limitations of using a theory of change approach. For example, theories of change require a simplification of the real world and, consequently, might miss important contextual factors and assumptions that may influence uptake of the mobile phone application and mobile phone-based growth-monitoring data. We therefore treat the theory of change as a developing framework that we aim to test, critique and revise as necessary throughout the evaluation process (Blamey and Mackenzie 2007; Funnell and Rogers 2011).

Figure 3.2 Theory of Change for evaluation of m-nutrition mobile phone application for posyandus



Source: Authors' own.

4 Overview of the evaluation design

4.1 Evaluation purpose and objectives

The overarching purposes of this impact evaluation are:

- To conduct a scientifically robust impact evaluation of the effect of the mobile phone application on nutrition service delivery in urban and rural posyandus in Indonesia.
- To generate learning about the contextual conditions under which the mobile phone application works and why, in order to inform the further development of the programme and its potential transfer to other settings.

The resulting specific objectives of the evaluation are:

For the growth monitoring component:

- To assess the impact of the mobile phone application on the accuracy of growth monitoring.
- To assess the impact of the mobile phone application on the timeliness of growth monitoring.
- To assess the impact of mobile phone-based growth monitoring on real-time responsiveness of cadres during the monthly posyandu.
- To assess whether more timely and accurate mobile phone-based growth-monitoring data may lead to increased responsiveness and better decision-making for child nutrition by the government and other stakeholders.
- To examine whether more timely and accurate mobile phone-based growth-monitoring data may improve the accountability of different stakeholders for their commitment to improved child nutrition (e.g. by ensuring coverage and quality of nutrition service delivery).

For the nutrition-counselling component:

- To assess the impact of the mobile phone application on the quality of home-based nutrition counselling.

The evaluation will start with a formative phase in the initial three months (the entire pilot study will run over 12 months). This formative evaluation aims to: (1) test the functioning of the mobile phone application; (2) assess the acceptability of the mobile application to the cadres, caregivers and other community members; and (3) examine the feasibility of the different data collection methods proposed for the different evaluation approaches chosen.

4.2 Selection of study sites

A total of 14 study sites has been selected in three macro areas of Indonesia, two urban and one rural, comprising, respectively, two, two and ten posyandus (see Table 4.1). The study sites (i.e. posyandus) for this study were purposefully selected by the World Vision team prior to the start of the evaluation. The evaluation will take place in all selected pilot sites. Selection criteria included proximity to major roads (to enable easy access), access to electricity (important to be able to charge the mobile phone) and existing partnerships between the posyandu and the local World Vision Indonesia team.[4] The participation in this

[4] World Vision Indonesia supports the delivery of nutrition services in the selected posyandus - for example, via capacity building and training of the cadres.

pilot and evaluation study is voluntary. All cadres in the study posyandus will be approached separately to seek their informed consent to participate in this study. If consent is refused, alternative posyandus will be selected based on the same criteria.

Table 4.1 Study site selection, number of cadres and children served

Study sites	Number of posyandus	Number of cadres	Number of children served by posyandu*
North Jakarta (Cilincing)	2	14	210
East Jakarta (Kebon Pala)	2	14	430
Sikka (rural)	10	50	500
Total	14	78	1140

*Children eligible and registered with the posyandu. The number of children attending monthly sessions varies.

The urban sites are located in Jakarta (two in East Jakarta and two in North Jakarta), with each serving approximately 100 to 200 children below the age of five; while the rural sites are located in the Sikka district and serve approximately 50 children each. The attendance rate in rural areas is usually higher, with more than 85 per cent of eligible children attending the monthly posyandu session, while attendance in urban areas stands between 50 and 70 per cent. Children below the age of one are more likely to attend regularly because they receive immunisations and free vitamin supplements during the posyandu days; older children attend less frequently (World Vision 2013).

The number of sites is small and cannot provide a representative sample of posyandus in Indonesia; however, they provide the opportunity for intensive case study analysis (GAO 1990).[5] The number of children covered, the efficiency of workflow and other contextual factors (e.g. access to electricity, network coverage, cadres' familiarity with and acceptance of mobile phones) are expected to vary between the sites and will be assessed based on a semi-structured context protocol during the study's initial, formative phase.[6] The context protocol will focus on factors of interest to this evaluation because they could affect the outcome – e.g. timeliness, accuracy, quality of nutrition counselling (see Table 4.2). The semi-structured nature of the protocol will allow for the collection of additional, unforeseen contextual factors.

An in-depth understanding of the context of each posyandu is important to understand and explain the impact of the mobile phone technology within the different settings (e.g. which factors may facilitate/promote or hinder uptake of the mobile phone solution). An assessment of the interaction between the contextual factors and the mobile phone solution and the consequences of this interaction is also important to the potential application of lessons learned from this evaluation to other programmes in Indonesia and elsewhere.

4.3 Process of selecting appropriate evaluation approaches

The choice of evaluation approaches needs to be determined by the evaluation's purpose and objectives (see 4.1), the contextual factors of the posyandus, the characteristics of the mobile phone intervention and an analysis of the problems of growth monitoring and nutrition counselling that the mobile phone application is intended to address (Hansen 2005).

[5] During the formative evaluation the team will decide whether all 14 study sites will be subject to the same intensive study or whether sites can be combined into fewer cases based on contextual factors.
[6] The first three months of this evaluation study will be formative and test the functionality of the mobile phone application, acceptability of the technology to cadres and caregivers and the different data collection approaches proposed for this evaluation.

Table 4.2 Context analysis of the study sites with factors that may affect the outcomes of the use of mobile phone technology for nutrition service delivery

Outcomes	Contextual factors
Timeliness of growth monitoring	Network coverage and funds for data transmission, differences in the posyandu growth-monitoring procedures, caregivers' attitudes towards the mobile phone
Accuracy of growth monitoring	Numeracy of the cadres, cadres' plotting skills, differences in the posyandu growth-monitoring activities, noise levels and other distractions during the posyandu
Quality of nutrition counselling	Counselling skills of cadres, language skills (>300 ethnic groups)
All outcomes	Access to electricity, education of the cadres, acceptance/familiarity of cadres with mobile phone, security issues (e.g. theft), environmental conditions that might affect mobile phone (e.g. dust, humidity, heat), cadre turnover, interactions and dynamics between cadres, dynamics of decision-making processes, perceptions, beliefs and opinions of the wider community about the mobile phone application, vulnerability to recurrent natural events (e.g. flooding, drought)

The team reviewed and compared alternative evaluation approaches, to identify, tailor and combine those most appropriate to address the objectives of this particular evaluation. As pointed out by Stern *et al.* (2012), it is often impossible to employ established quantitative evaluation approaches such as randomised controlled trials (RCTs) for impact evaluation studies[7] due to characteristics of the interventions and/or ethical or contextual factors (as is the case in this evaluation). The evaluation team had to seek out new approaches and draw on quantitative and qualitative techniques from different disciplines and practices to be able to conduct a rigorous impact evaluation in this case.

As already mentioned, to inform the development of the evaluation design, the IDS/World Vision team conducted an initial field visit to the pilot sites in February 2014. Our aim was to observe the environment in which the mobile phone technology was to be piloted, including observation of the different activities of nutrition service delivery in the posyandus, scrutiny of the mobile phone application in action in the beta-testing[8] phase in urban Jakarta and examination of contextual factors that might influence the uptake of the technology. The team also conducted focus group discussions and in-depth interviews with cadres, community health workers, midwives and mothers to gain better insight into the complex and multifaceted factors that might interact with the technology at different levels. Furthermore, the team met with the local programme implementers to learn more about the field teams' expectations, motivations and fears regarding the mobile phone technology. This was done in an attempt to understand the opportunities and constraints determining the best approaches or combination of approaches for the evaluation.

4.4 Summary of evaluation approaches used

Table 4.3 provides a summary of evaluation questions, the selected evaluation design and the rationale for the design choices. A detailed description of the development of the evaluation questions and design selection will be presented in Sections 6 and 7.

[7] In fact, it has been suggested 'that that only 5 per cent of development programmes of donors such as DFID are suitable for randomised controlled trials' (Stern *et al.* 2012).
[8] Beta-testing describes the external acceptance testing of a software with a group of intended users.

Table 4.3 Summary of evaluation questions, approaches and rationale

Evaluation question	Evaluation approach	Design rationale
Growth monitoring component		
How much does the mobile phone application improve the accuracy of growth-monitoring data?	Counterfactual-based: Mill's Method of Difference	Statutory reporting obligations of posyandus. Paper-based and mobile phone-based growth monitoring need to be conducted in parallel.
How much does the mobile phone application improve timeliness of data submission?	Counterfactual-based: Mill's Method of Difference	Statutory reporting obligations of posyandus. Paper-based and mobile phone-based growth monitoring need to be conducted in parallel.
How much and why does the mobile phone solution increase the responsiveness of the cadres during the posyandu (i.e. provision of immediate feedback and set-up of home-based nutrition counselling session)?	Counterfactual-based: Mill's Method of Difference Mechanism-based: Realist Evaluation	Statutory reporting obligations of posyandus. Paper-based and mobile phone-based growth monitoring need to be conducted in parallel. Evidence (literature and scoping visit) that responsiveness to the growth-monitoring data in the posyandu is low.
What contextual factors may influence the use of mobile phone-based growth-monitoring data to inform nutrition-related decision-making processes including responsiveness and accountability?	Political economy analysis of nutrition-related decision making with stakeholder interviews	Impossible to assess systemic changes based on a small and short-term pilot study. Identification of contextual conditions that promote/hinder decision-making based on real-time mobile phone-based growth monitoring.
Nutrition-counselling component		
How and why does the mobile phone application improve the quality of nutrition counselling?	Mechanism-based: Process Tracing	Detailed knowledge about quality criteria for different steps of home-based counselling are available; opportunity to find specific evidence that mobile phone can be directly related to these criteria.

Sections 6 and 7 will outline the decisions and choices the evaluation team made in selecting a suitable combination of approaches to address the evaluation questions. The following section (Section 5) will briefly outline the aims of the formative phase of this evaluation.

5 Formative evaluation phase

5.1 Purpose and objectives of the formative phase

The first three months of this evaluation study will be formative and will focus on the implementation of the mobile phone application in the 14 study posyandus. The overall purpose is to generate an understanding of how the mobile phone application is implemented and what factors may affect this.

The objectives of the initial formative phase are:

- To test the mobile phone application in the nutrition service delivery in the posyandus.
- To examine the acceptability of the mobile application to the cadres and caregivers.
- To examine the feasibility of the different data collection methods that are part of this evaluation study.

As part of these objectives, the initial phase will set out to identify the strengths and weaknesses of the mobile phone application as perceived by the cadres and reveal potential obstacles and barriers to its use, as well as unexpected opportunities (Glasgow and Linnan 2008).

5.2 Data collection in the formative phase

The formative phase will be explorative and will draw on literature on the adoption of innovations by individuals and within organisational settings and dynamics (e.g. Moore and Benbasat 1991; Cooper 1998; Damanpour and Schneider 2006). A number of data-gathering tools will be employed, including semi-structured interviews (including instruments on the perceptions of using technology innovations (Moore and Benbasat *op. cit*.), observations and focus groups with cadres, programme implementers and caregivers. Cadres will also act as participant-observers (Atkinson and Hammersley 1994) and keep a diary to record any technical problems and other relevant observations. This method will provide in-depth insights into the potential challenges and opportunities of the mobile phone technology in the posyandu.

The in-depth interviews with cadres will help to explore how they use the mobile phone application, whether the mobile phone triggered changes in their usual behaviour, what challenges and opportunities the application might offer, which features they perceive as particularly useful and which seem less useful for growth monitoring and nutrition counselling.

In addition, during the focus group discussions, the acceptability of the mobile phone application to cadres and caregivers will be assessed using a user-acceptability scale that will be developed during this inception phase of the evaluation.

The contextual analysis of the 14 posyandus will also be conducted at this time (see 4.2).

6 Evaluation of the growth-monitoring component

6.1 Evaluation of the impact of the mobile phone application on growth monitoring in the posyandu

The objectives of the evaluation of the use of the mobile phone application for posyandu-level growth monitoring are:

- To assess the impact of the mobile phone application on the accuracy of growth monitoring.
- To assess the impact of the mobile phone application on the timeliness of growth monitoring.

Based on our observations of the growth-monitoring activities in the posyandu during the field visit in February 2014 and interviews with the cadres and World Vision field staff, specific threats to both accuracy and timeliness were identified. We outline these threats below and ways in which the mobile phone application could help to address them. Based on this outline, we then developed specific evaluation questions and chose our approaches to the evaluation, as detailed below.

6.1.1 Data accuracy

The production of accurate data is essential for effective growth monitoring and management of the nutritional status of children at community level (Ashworth, Shrimpton and Kamil 2008; Cemeroglu, Kleis and Robinson-Wolfe 2011; Foote *et al.* 2011; Liu, Long and Garner 2012). Doubts about the accuracy of growth-monitoring data have been identified as a major reason for why data is not taken up by local, regional and national policymakers to inform nutrition-related decision making – for example, when allocating resources for nutrition services (Shoham and Watson 2001). During the field visit to the posyandus, low data accuracy was identified as a potential concern (see Section 2.3.3). Three potential periods of threat to data accuracy were identified:

i. During data entry
ii. During plotting and interpretation of the growth curves
iii. During data aggregation for summary reports

i. Threats to data accuracy during data entry

During the growth-monitoring activities in the posyandu, Cadre 2 at Desk 2 (the weighing station) orally communicates the anthropometric measurements to Cadre 3 (or in some cases an additional cadre at Desk 2). The data for each child are manually entered into individual temporary paper slips. The slips are passed on to the next cadres and are used to plot individual growth charts and for the manual completion of summary reports and different types of registries for both internal purposes (e.g. the growth chart for mothers, the posyandu registration book) and external purposes (e.g. summary reports for different local authorities including the local health centre and the health office at sub-district level). The repeated manual transfer of the raw data increases the risk for data entry error enormously (e.g. missed decimal point, errors due to illegibility).

The mobile phone application can reduce the risk of data entry errors as the raw data need to be entered only once. The application allows the cadres to identify automatically the nutritional status of the individual child.

ii. Threats to data accuracy during plotting and interpretation of the growth curves
To assess a child's nutritional status and growth velocity,[9] Cadre 3 needs to plot the anthropometric measurements of the child on the growth chart and interpret the child's pattern of growth based on the growth chart. Incorrect plotting and interpretation has been identified as a common threat to accurate growth monitoring, both in the literature and during our field visit (Ashworth *et al. op.cit*.; Foote 2014).

The mobile phone application can reduce the risk of inaccurate plotting and thus incorrect assessment of the nutritional status and growth velocity of a child because it allows cadres to calculate automatically and correctly z-scores based on the anthropometric measurements.

iii. Threats to data accuracy during data aggregation for summary reports
The accuracy of summary reports may be low because of the repeated manual transfer of the raw data and associated errors. The mobile phone can reduce this potential threat, as summary reports and further data processing can be carried out automatically from the main database and require no additional data entry or transfer.

It is important to remember that while the mobile phone application may be able to increase data accuracy, it cannot ensure or improve the reliability of the anthropometric measurements taken. Collection of reliable anthropometric measures is difficult and has been shown to be affected by multiple errors and various biases,[10] e.g. technical problems with equipment, lack of training (Ulijaszek and Kerr 1999; Gibson 2005). Regular quality checks of cadres' weighing efficiency (e.g. by re-weighing), checks of equipment and training of the cadres can help to ensure high-quality anthropometric measurements.

Evaluation question to assess the impact of the mobile phone on data accuracy

The resulting evaluation question is as follows:

> How much does the mobile phone application improve the accuracy of growth-monitoring data?
>
> In particular, how much does the application improve data accuracy?
>
> i. During data entry
> ii. During plotting and interpretation of the growth curves
> iii. During data aggregation for summary reports.

6.1.2 Timeliness of data submission

Timely submission of growth-monitoring data to local and district level authorities is important in order to inform decision-making such as resource allocation to the posyandus and facilitate responsiveness to sudden events that can have an impact on the nutritional status of children (e.g. an increase in diarrhoeal diseases or malaria after flooding).[11] Data submission in traditional paper-based systems is often very time-consuming, as the data forms need to be transported and manually entered into an electronic database (in Indonesia, this happens at the sub-district level). Further work (and additional time) is also needed if data need to be aggregated before submission, as is the case in the posyandu system. During our field visit we learned that cadres are required to send up to 12 summary reports to various higher-level health facilities and authorities including local midwives, village

[9] Definition growth velocity: the rate of growth or change in growth measurements over a period of time, based on weight, height and age measurements.
[10] The mobile phone solution will include prompts for accurate process (e. g. remove child's clothes before weighing; calibration of scale).
[11] Assumptions and long-term goals regarding data-driven decision making related to nutrition service delivery at the posyandus are assessed in more detail in Section 2.3.4.

health post, sub-district health centre, Family Empowerment and Welfare (FEW) group and urban employment authorities (in urban areas caregivers are asked about their employment status as part of the posyandu procedures).

The mobile phone solution has the potential to increase the timeliness for data submission, as data can be uploaded in real time to a central server. However, real-time data submission requires network connectivity at or close to the posyandus to be available. If network coverage is absent, poor or fluctuating, data submission is likely to be delayed. Observations during our field visit suggest that network connectivity is likely to vary between the pilot sites. Seasonality may further affect network coverage.

Evaluation question to assess the impact of the mobile phone on timeliness

The specific evaluation question is:

> How much does the mobile phone application improve the *timeliness* of data submission?
>
> In particular, what type of information (i.e. aggregated summary reports) is available at what time after the posyandu days in the two systems?

6.1.3 Design approaches to evaluate the impact on accuracy and timeliness: Mill's Method of Difference

The evaluation team considered the use of different and common causal inference models for impact evaluation including RCTs, quasi-experiments and natural experiments. The field visit in February suggested that the selection of an appropriate counterfactual (e.g. using a control group that did not receive the mobile phone) would pose a significant barrier to the use of the common causal inference models. Since the study sites had already been selected, randomisation was no longer possible and a RCT was impossible.

Nevertheless, the selection of comparable control sites was still feasible. Control sites need to be selected to match the treatment sites as closely as possible on all social, technical, economic and other characteristics that may be relevant for the uptake and impact of the mobile phone application for nutrition service delivery in the posyandus. Consequently, the process of identifying well-matched control sites would be a very time-consuming and resource-intensive task.

However, the statutory reporting obligation of the posyandus and the associated impossibility to suspend paper-based data collection in the treatment sites (see Section 4.2.1), posed an additional challenge to the design. The team realised that it would only be possible to introduce the mobile phone in addition, and in parallel, to the paper-based growth-monitoring activities in the posyandu. This means that, in the treatment sites, the growth-monitoring data for each child will be collected using the mobile phone application *together with* the paper-based procedures. A comparison could thus only be made between paper-based data collection plus mobile phone-based data collection, as treatment; and paper-based collection only, as control. The treatment sites were not 'mobile-phone only' sites, but a combination of mobile phone and paper-based data collection. Consequently, a comparison of outcomes from the treatment sites with the outcomes derived from paper-based control sites would be of relatively low value and would not allow us to discern the impact of the mobile phone application; but rather of a combination of two procedures.[12] This constraint prevented the team from choosing any treatment-control design where treatment groups are different from control groups.

[12] In the long term, the mobile phone application might be able to replace the paper-based data collection completely.

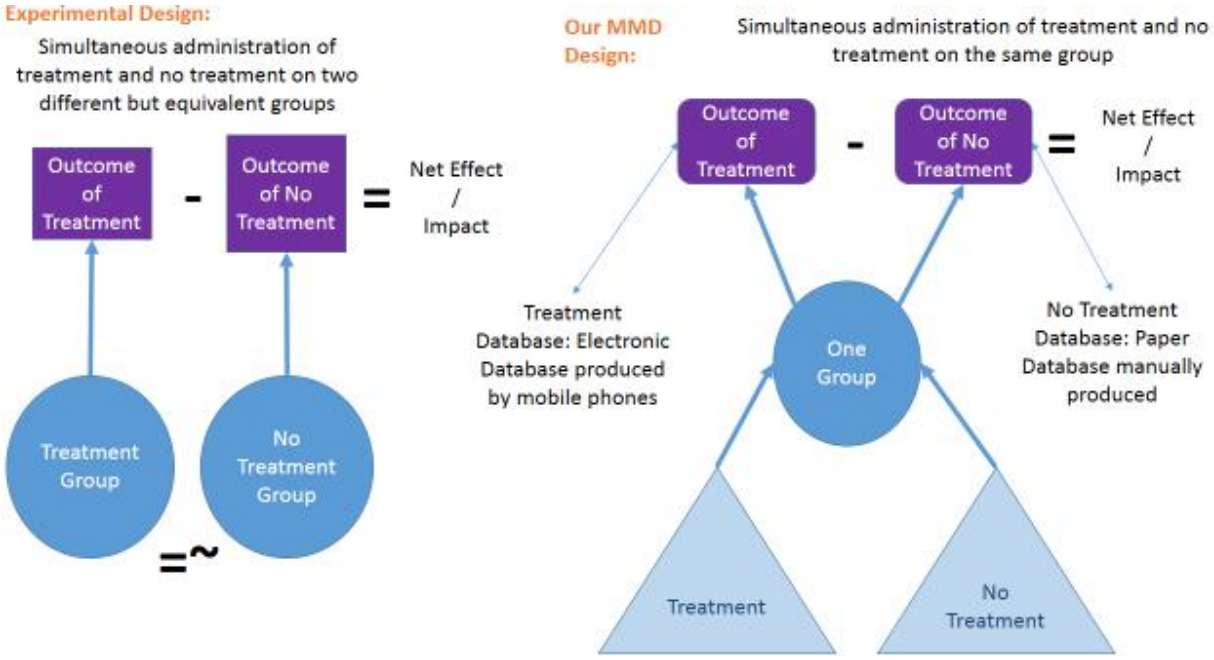
While discussing these challenges and observing the growth-monitoring procedures in the posyandus, the team realised that, rather than constituting an obstacle to a rigorous evaluation design, the simultaneous application of the two data collection approaches could still offer an opportunity to apply a rigorous, comparative causal inference design, which would not be an RCT, a quasi-experiment or a natural experiment, but would still be based on the same causal inference logic (Mill's Method of Difference) (Stern *et al. op. cit*.). The two procedures (mobile phone-based and paper-based) are applied simultaneously to the same population of children and generate separate outcomes immediately after (child's data records with nutritional status and growth velocity, both on paper and on the mobile phone). This means that any difference in the outcomes cannot be attributed to any plausible cause other than the different performances of the two technologies (see Figure 6.1).

Indeed, if we proceed by successive elimination of causal alternatives, we notice that:

- First, the difference in the outcomes of the procedures cannot be attributed to the differences between two populations (as in treatment and control groups) because the two procedures are applied to the same population.
- Secondly, the difference cannot be attributed to different contextual conditions present at different administration times because the two procedures are applied simultaneously.

Having eliminated two major causes of differential effects in interventions (differential characteristics of the population and time frame of the treatment), the only plausible causal factor remaining is presumably the intervention itself: or the additional capacity of the mobile phone technology to produce more accurate and timely data compared to the paper-based procedure.

Figure 6.1 Comparison between the experimental design and Mill's Method of Difference design used for the impact evaluation of mobile phone technology



Source: Authors' own.

This causal inference design is not normally identified as an experiment, as there are no treatment and control groups. It is the same group that receives both – the treatment and no treatment – and produces separate outcomes following each of these simultaneous

processes (see Figure 6.1 below). However, it is the same rigorous causal inference logic that is at the basis of counterfactual designs: Mill's Method of Difference (Mill 1843; Rihoux and Ragin 2009; Befani 2012; Stern *et al. op. cit*.; Befani 2013). This procedure of attributing one effect to one cause is based on the comparison of two almost identical cases that differ only in the effect (e.g. more timely or accurate growth-monitoring data) and the cause (e.g. the treatment, the mobile phone technology), while all other plausible causes are the same (e.g. same population, same time frame of administration, same contextual conditions, etc.).

In our intervention, the outcomes (such as timeliness and data accuracy) are calculated from two databases, one obtained with the mobile phones and the other obtained with the paper-based system. The difference in the effects can only be attributed to the differential effectiveness of these two procedures; or, in particular, to the added value of the mobile phones over the paper-based process.

If this difference in performance is to be used to estimate the performance of mobile phones-only in a no-pen-and-paper situation, it is essential that the interaction between Cadre 3a and the other cadres is controlled. Field observations conducted suggest that, during posyandu days, cadres are involved in separate activities and are based on different desks. Interaction between cadres in the posyandu is low. The evaluation team intends to ensure that data for the comparison are included in the database only if a local observer certifies that interaction between Cadre 3a and the other cadres has been low during the posyandu day. Data collected in situations where such interaction is not minimal will not be used for the analysis.

6.2 Evaluation of the impact of the mobile phone application on responsiveness in the posyandu

The objective of this sub-component of the evaluation is:

- To assess the impact of mobile phone-based growth monitoring on the responsiveness of cadres during the monthly posyandu.

According to the literature, an important element of effective community-based growth monitoring is to raise mothers' and caregivers' awareness of the nutritional status of the child, reassure and empower them to track the child's nutritional health and take adequate actions to improve in case growth faltering is detected (Ashworth *et al. op. cit*.; Cemeroglu *et al. op. cit.*). The mobile phone application may increase responsiveness on both occasions as described in the following.

6.2.1 The provision of real-time feedback on nutritional status and growth velocity

According to Figure 2.5 in Section 2.3, Cadre 3 at Desk 3 is meant to plot and interpret the individual growth chart and provide immediate feedback to the caregiver on the child's nutritional status and growth velocity. Feedback could include giving brief reassurance to the caregiver that the child is doing well, or highlighting an existing problem in cases where growth faltering is detected. The literature suggests that nutrition feedback provision (and nutrition counselling) in the posyandus has declined considerably during the last decades mainly due to a lack of training for the cadres (Februhartanty *op. cit.*). The evaluation team's observations of the posyandu procedure confirmed this and interviews with caregivers in the posyandus suggested that real-time feedback (either reassurance or highlighting of a problem) is rarely provided. In focus group discussions, the cadres explained that they felt uncomfortable telling a mother that her child is not doing well because mothers tended to be offended and react defensively. Caregivers perceived negative feedback as publicly blaming them for not taking care of the child properly.

In this context, the cadres pointed out that the mobile phone application might positively influence their propensity and willingness to provide immediate feedback, including the highlighting of nutritional problems. Feedback based on the calculation of the mobile phone was perceived as a more objective third-party assessment and less like the subjective opinion of a cadre. Cadres expected that caregivers might be less likely to challenge and be offended by this feedback.

Evaluation question to assess the impact of the mobile phone on real-time feedback provision

The specific evaluation question is:

> How much and why does the mobile phone solution increase the propensity to provide real-time nutritional feedback during the posyandu day?
>
> In particular, what are the relative percentages of caregivers provided with real-time feedback on the nutritional status and growth velocity of the child with and without the mobile phones?

6.2.2 Appointment for home visits and referrals

Home-based counselling to promote good childcare and feeding practices has been shown to be effective in improving child nutrition (Morrow *et al.* 1999; Bhandari, Kabir and Salam 2008; Lutter *et al.* 2013). Counselling at home allows the cadre to assess feeding and childcare practices, provide tailored behaviour-change messages and discuss new behaviours with the caregiver. During the posyandu procedures (Figure 4), Cadre 4 is responsible for setting up home visits or (in case of severe undernutrition) referral to the health facility for treatment and rehabilitation. Individual-level nutrition counselling is not feasible during the often very busy and overcrowded posyandu days. During these days, weighing often takes place in parallel with education or recreational activities. In some urban posyandus (including in the treatment posyandus in East Jakarta), anthropometric measurements of more than 200 children are taken and recorded in less than two hours. Individual-level counselling would be impossible and unethical (as there is no privacy) under these conditions. The arrangement of individual home visits is essential, but is often neglected or is conducted in a haphazard manner.

Mobile phones can potentially increase the percentage of undernourished children that are followed up and receive referrals or home-based counselling following the posyandu. The application will send an automatic message to the cadre highlighting the need for a home visit or referral and will also guide the selection of a day and set-up of an appointment.

As with the feedback provision, cadres are likely to feel more comfortable setting up appointments, as they might feel ‘authorised’ by the message sent via the software and not based on their own assessment and calculations following the plotting of the growth chart.

Evaluation question to assess the impact of the mobile phone on the real-time arrangement of appointments for home-based counselling

The evaluation is guided by the following question:

> How much and why does the mobile phone improve the propensity to arrange a home-based counselling session or referral during the posyandu visit?
>
> In particular, what are the relative percentages of undernourished children followed up and receiving an appointment for home-based counselling or referral to the health facility following the posyandu, with and without the mobile phone?

6.2.3 Design approaches to evaluate the impact on responsiveness in the posyandu: Mill's Method of Difference and Realist evaluation

The evaluation team considered several approaches in order to address the evaluation questions.

Option 1: Use of the same comparative causal inference design based on Mill's Method of Difference as described in 2.3.2, plus a direct observation of the posyandu procedures. For this option, an observer would be present during the posyandu day and would continuously record cadres' practices and behaviours in providing real-time nutritional feedback and arranging appointments as they occur. Directed by a structured observation protocol/checklist, the observer would systematically note whether feedback is given and home visits are arranged by the cadres with or without the mobile phone. The observer would also collect data on other dynamics related to the responsiveness to growth monitoring.

There are several potential threats that may affect the accuracy and validity of the data collected via direct observation during the posyandus. These include (Repp *et al.* 1988): (1) reactivity, meaning the cadres react to the presence of the observer and change their behaviour accordingly; (2) observer drift, which describes a gradual shift of the attention of the observer that can result in inconsistencies in the recording of the observed target behaviours (i.e. provision of feedback and arrangement of home visits); (3) errors during the recording procedures, for example because the observer gets distracted by other activities during the posyandu or has problems hearing the cadres due to background noise (e.g. crying or playing children, laughing caregivers); (4) observers' expectations of the cadres' behaviours and the benefits of the mobile phone technology; (5) challenges to inter-observer reliability, for example, if different observers collect data at the same posyandu centre and during different posyandus; (6) characteristics of the observer (e.g. gender, status, relation to World Vision, the local community) and the cadres (e.g. age, socio-economic status, status in the local community). To address these threats and increase the accuracy of the observer, Repp *et al.* (*op. cit*.) recommend: meticulous training of the observers, an initial 'adaptive period' for cadres and observers to become familiar with each other and to reduce the risk of reactivity, unobtrusive observation set-up (e.g. behind the desks of the cadres), careful recruitment of the observers and clear observation protocols without ambiguity.

Option 2: Use of the same comparative causal inference design based on Mill's Method of Difference as described in 2.3.2, plus exit interviews with all caregivers. For this option, an interviewer (or several interviewers, to prevent delays) would conduct a short survey with all caregivers immediately after the posyandu. The survey would cover questions on the provision of real-time nutrition feedback, set-up of home visits and whether a cadre with or without a mobile phone conducted these tasks. The survey could also collect data on the caregiver's overall experience of the posyandu day and her/his perceptions, observations and experiences of the mobile phone throughout the process. An exit interview with the caregiver would be less intrusive, although there is the risk of incomplete coverage (e.g. caregivers refuse to be interviewed), interviewer and social desirability bias (e.g. caregivers reply in a manner they think is expected, for example, they praise the benefits of the phone).

A combination of the two different options (e.g. options 1 and 2 in alternate months) would allow the evaluation team insights from multiple perspectives into how the mobile phone application may influence the provision of feedback and the arrangement of home visits. Additional in-depth interviews of the cadres immediately after the posyandu could provide further insights into cadres' practices of providing nutritional feedback and arranging home visits and their experiences, perceptions and use of the mobile phone application. As the pilot and evaluation study will last for 12 months, the team can also collect data on potential changes in cadres' behaviour over time. For example, as cadres become more familiar with

the technology and start to trust it, they might feel empowered to provide nutritional feedback based on the calculations of the mobile phone application more frequently.

The combination of options also aims to collect data on the following: (1) total number of children measured; (2) total number of children who have received nutritional feedback from the cadre using the mobile phone; (3) total number of children who have received real-time feedback from the cadre using pen and paper; (4) total number of children who have received appointments or referrals from the cadre using the mobile phone; (5) total number of children who have received appointments or referrals from the cadre using pen and paper.

For the different design options to be robust, all caregivers should have the same probability of receiving feedback from the cadre using the mobile phone and the cadre using pen and paper. In order for this to happen, the physical location of the different desks and cadres in the posyandu centre and proximity of the caregivers to the cadres with and without mobile phone need to be carefully considered. For example, it is important that anthropometric data from Desk 2 are communicated to both the cadres with and without a mobile phone. Interactions between the cadres with and without mobile phone need to be kept at a minimum (see also growth-monitoring component), and guidelines provided to the cadres with and without mobile phone need to be identical (e.g. cadres with mobile phone should receive the same level of encouragement and guidance with regard to the provision of nutrition feedback as cadres without a phone). However, the evaluation team expects that cadres in each treatment posyandu will develop and employ unique context-specific approaches for the integration of the mobile phone application into the different growth-monitoring activities, including the provision of feedback and the arrangement of home visits.

To examine the underlying mechanisms that may lead to increased responsiveness and identify 'what works, how, for whom and under what circumstances', a realist evaluation approach will also be employed (Pawson and Tilley 1997). The assumption of realist evaluations is that underlying mechanisms (M) triggered by the programme interact with the social, political, personal context (C) to produce varying outcomes ('mechanisms + context = outcomes' or CMO) (Pawson and Tilley *op. cit*.). Consequently, the use of the mobile phone application by cadres to facilitate the growth monitoring could result in different reactions and behaviours by the cadres (= outcomes). Drawing on existing evidence, the evaluation team will map out different mini-theories called context mechanism outcomes (CMO), i.e. configurations that will bring together different contextual factors with potential mechanisms and outcome (Pawson and Tilley *op. cit*.; Pawson 2013). The CMOs will be developed in the inception phase of this evaluation study. Qualitative and quantitative data collected through direct observations of growth-monitoring activities and in-depth interviews with cadres will be used to better understand, refine or refute the different CMOs. The aim is to identify different outcome patterns for different contexts in which the mobile phone application is used to aid the growth-monitoring process.

6.3 Evaluation of the impact of the mobile phone application on responsiveness of the government and other stakeholders

The objectives of this sub-component of the evaluation are:

- To assess whether more timely and accurate mobile phone-based growth-monitoring data may lead to increased responsiveness and better decision-making for child nutrition by government and other stakeholders.
- To examine whether more timely and accurate mobile phone-based growth-monitoring data may improve accountability of different stakeholders for their commitment to improved child nutrition (e.g. by ensuring coverage and quality of nutrition service delivery).

6.3.1 Responsiveness and accountability at government-level

Growth-monitoring data collected in the posyandu using the mobile phone application may be more accurate and its submission to health offices and other stakeholders may be timelier than the traditional paper-based data. Improved timeliness and accuracy may in turn increase data credibility and may persuade decision makers to trust and increase the use of posyandu-level data to inform nutrition-related decision making and to track the distribution of undernutrition (see 1.1.3 regarding the reluctance of decision makers to use posyandu-level data) (Gillespie *et al.* 2013; Barnett and Edwards 2014). Timely data may also trigger a more rapid response to nutritional crises caused by the natural disasters that are common in Indonesia, e.g. floods, earthquakes, volcano eruptions, landslides, droughts (LDEO and Colombia University 2014). Access to credible mobile phone-based data (e.g. via the real-time surveillance database) may enable civil society (including World Vision Indonesia and local organisations) to use the data to hold different stakeholders accountable for the quality, availability of resources for and coverage of nutrition services – e.g. government, civil society, cadres and themselves (Gillespie *et al. op. cit.*). At the national level, timely (or nearly real-time data) may help to increase the visibility of undernutrition and may improve capacity to respond effectively and appropriately to changes in nutrition.

This pilot and evaluation study will be conducted in only 14 treatment posyandus (i.e. data collected will not be representative at sub-district or district level) and over a period of just 12 months. Consequently, it is impossible to assess whether mobile phone-based nutrition data will bring about systemic changes including changes in district and national-level decision-making processes, responsiveness to crises, accountability processes and advocacy for nutrition. However, it will be possible to identify contextual factors and conditions that may act as levers and facilitate or hinder the uptake and effective use of mobile phone-based data. For example, nutrition-related decision-making has been shown to be influenced by several factors, including historical nutrition survey data, economic evaluations, recommendations of an expert panel, wishes of different interest groups, district- and national-level priorities, personal affiliations or interests of decision-makers and even emotions (Choi *et al.* 2005; Barnett and Edwards *op. cit.*). These factors may all compete with or prevent the uptake of mobile-based growth-monitoring data to inform decision-making. Similarly, the effectiveness of (real-time) nutrition data in accountability processes is influenced by the existing interaction dynamics between decision-makers and citizens and social, political and economic factors and dynamics (George, Iyer, and Sen 2005; Goetz and Jenkins 2005; Cornwall and Coelho 2007; Lodenstein *et al.* 2013). A better understanding of contextual factors and conditions to data uptake and use is important to develop effective mobile phone-based growth-monitoring systems that may increase responsiveness, lead to action and may ultimately be scaled up throughout Indonesia and replace paper-based systems. The replacement of paper-based growth monitoring by mobile phone-based growth monitoring is one of the long-term goals of World Vision.

Evaluation questions to assess the impact of the mobile phone on the responsiveness of governments and other stakeholders

In summary, the evaluation questions for this component are:

> What contextual factors influence the use of mobile phone-based growth-monitoring data to inform nutrition-related decision-making processes including responsiveness to nutritional crises?
>
> This includes nutrition-related decision-making at all governance levels (i.e. community, sub-district, district and national) and across different stakeholders.
>
> What contextual factors influence the use of mobile phone-based data to ensure accountability for nutrition?

This includes processes of holding different stakeholders accountable for the quality, availability of resources for and coverage of nutrition services.

What other contextual factors and conditions may hinder or facilitate the long-term replacement of paper-based growth monitoring with mobile phone-based monitoring in the posyandus?

6.3.2 Design approaches to evaluate the impact on responsiveness of the government: political economy analysis with stakeholder interviews

To address the first question, an analysis of nutrition governance in Indonesia will be conducted. The focus will thereby be on current decision-making processes and resource flows to nutrition and nutrition services. As part of this, reasons for the current reluctance of decision-makers to use posyandu-level data as well as other factors that influence decisions with regard to nutrition will be explored. Stakeholder interviews with district and national-level decision-makers and other stakeholders will also assess the capacity and motivation to use mobile phone-based data. A political economy approach will be employed that includes literature and document review and stakeholder interviews (Acosta and Pettit 2013).

Like the first question, the second question will be addressed using a political economy analysis of nutrition governance in Indonesia. The focus will thereby be on the identification of potential contextual factors, relationships between actors and conditions that may enable or hinder the use of mobile phone-based data to ensure accountability for nutrition and nutrition service delivery in the posyandus. It will also include a mapping of other formal and informal accountability structures for nutrition. Evidence reviews and stakeholder interviews will be performed.

To tackle the last question, the mobile phone-based growth-monitoring system needs to be compared with the paper-based system. The paper-based system complies with strict reporting obligations, with different summary reports required to be sent to different stakeholders. The use of paper as an initial medium to store the information has implications in terms of administrative processes, staff, political control and, ultimately, power. The replacement of the paper-based system with mobile phone-based system requires an understanding of the specific data needs of the different stakeholders and negotiation and multi-sectoral collaboration between those stakeholders. Stakeholder interviews and political economy analysis will be used to explore barriers, challenges and opportunities for the replacement of paper-based data collection with mobile phone-based data.

7 Evaluation of the nutrition-counselling component

7.1 Evaluation of the impact of the mobile phone application on home-based nutrition counselling

The objective of the evaluation of the use of the mobile phone application for the nutrition counselling is:

- To assess the impact of the mobile phone application on the quality of home-based nutrition counselling.

Based on a review of the literature on nutrition counselling, observations during the field visit and focus group discussions with cadres, threats to quality were identified in three successive elements of the nutrition-counselling activities in the posyandus. In the following section these threats and how the mobile phone application might address them will be described. This is followed by specific evaluation questions and context-specific approaches.

7.1.1 Quality of nutrition counselling

The literature suggests that growth monitoring as a stand-alone activity is not effective in improving child nutrition (Garner, Panpanich and Logan 2000; Roberfroid *et al.* 2005; Bryce *et al.* 2008). However, growth monitoring combined with effective follow-up nutrition interventions to promote healthy child weight and growth (e.g. nutrition counselling) have been shown to be effective in improving child nutrition (Alderman 2007; Ashworth *et al. op. cit.*).

For nutrition counselling to be effective it needs to be based on a careful *initial assessment* of behavioural patterns and household-specific barriers to healthy child feeding practices (Caulfield, Huffman and Piwoz 1999; Bhutta *et al.* 2013). Based on the assessment, tailored behaviour-change messages need to be provided.

Home-based counselling in selected treatment sites is based on UNICEF's generic counselling packages for community-based infant and young child feeding practices (UNICEF 2010).[13] The packages provide training tools that are used by local World Vision staff to train cadres in conducting effective home-based nutrition counselling. The training aims to enhance cadres' technical knowledge about correct infant and child feeding practices, to improve their counselling skills, including reaching-an-agreement skills (negotiating) and to increase their problem-solving skills (see Appendix A for the general guidelines for positive counselling). Cadres are instructed to use the three-step approach 'assess, analyse and act' for the home-counselling sessions. The initial assessment should include the following (UNICEF 2013a) (see Appendix B):

1. Assessment of the age of the child
2. Number of older children
3. Health status of the child
4. Discussion of the child's growth chart
5. Breastfeeding practices (frequency, difficulties, when and why stopped)
6. Liquid intake of the child (what, when, how much)

[13] www.unicef.org/nutrition/index_58362.html.

7. Complementary feeding practices (types of food with a focus on animal protein, legumes, fruit/vegetables and staples; amount, frequency, texture, challenges)
8. Feeding behaviour (responsive feeding practised or not)
9. Hygiene practices (hand-washing behaviour, cleanliness of cutlery).

The cadre then needs to **analyse the information** provided by the caregiver(s) and identify difficulties and challenges with regards to child feeding and care practices. If there are several challenges, she needs to prioritise and address the most important problem first. The cadre then **provides tailored behaviour-change messages and advice**, taking the caregiver's specific situation and challenges into consideration. Cadres are encouraged to use a reaching-an-agreement approach when providing advice (UNICEF 2012). This means that cadres discuss and negotiate behaviour change options with the caregiver and provide only small amounts of relevant information (rather than overloading the caregiver with large amounts of general information on child feeding practices). The aim is to find and agree on small doable and realistic solutions to address the challenges identified.

The mobile phone application has the potential to improve the **quality of the home-based nutrition counselling** by supporting each of the three steps ('assess, analyse and act') of the home-based nutrition counselling. More specifically, the mobile phone application can help to: (1) ensure a comprehensive initial assessment of the current child feeding practices via a brief interactive survey that cadres have to complete with the caregiver at the beginning of the session; (2) analyse the information provided in the initial assessment and highlight practices and behaviours that divert from the optimal; and (3) provide tailored behaviour-change messages based on identified diversions from optimal behaviour. However, the application might also make the interaction between the cadre and the caregiver too structured and 'mechanical', preventing the cadre from making full use of her negotiation abilities and thus potentially hindering the successful outcome of the counselling. UNICEF has developed a checklist to help supervisors assess community health workers' performance with regard to each of the three steps of home-based nutrition counselling (see appendix C).

Evaluation question to assess the impact of the mobile phone on the quality of home-based nutrition counselling

> How and why does the mobile phone application improve the quality of nutrition counselling?
>
> In particular, does the application have an impact on the quality of counselling during the:
>
> i. Initial assessment of current child feeding practices
> ii. Analysis of the initial information and identification of challenges
> iii. Provision of tailored behaviour-change messages to the caregiver?

7.1.2 Design approaches to evaluate the impact on quality of nutrition counselling: process tracing

The evaluation of the impact of the mobile phone application on nutrition counselling will focus on the three steps of home-based nutrition counselling: (i) the initial assessment of current feeding practices; (ii) the analysis of the initial information and identification of challenges; and (iii) the provision of tailored behaviour-change messages to the caregiver.[14]

[14] The evaluation team also considered the use of an experimental design (RCT) with a treatment group of caregivers who received counselling with mobile phone and a comparison without the mobile phone. However, given that the average number of counselling session following the posyandu is small, tests for statistical differences between treatment and comparison are not permitted. The construction of an appropriate comparison group is also difficult given the small sample.

i. Initial assessment

For the evaluation of the impact of the mobile phone application on (i) the initial assessment of current child feeding practices, the features and the procedures of mobile phone-based assessment will be compared with the criteria laid out in the checklist for the appraisal of cadres' performance during home-based counselling developed by UNICEF (see Appendix C). The comparison will include direct observations of the counselling process and will allow the evaluators to assess the comprehensiveness of the assessment. To examine whether the mobile phone-based assessment makes the assessment process easier for the cadre, more reliable and complete, and reduces errors (e.g. omissions), a comparison with the traditional process will be conducted. In-depth interviews with cadres and caregivers immediately after the home-based counselling will provide further insights into the experiences, perceived challenges and barriers associated with using the mobile phone application in the assessment process.

To unwrap the causal mechanisms between the use of mobile phone technology and the quality of the initial assessment, process tracing will be used. Process tracing originates in the social sciences and aims to 'examine diagnostic pieces of evidence with the goal of achieving and refining causal inference' (Collier 2010). Process tracing is increasingly used for small n impact evaluation,[15] e.g. by Oxfam (Hughes and Hutchings 2011).

Process tracing will start with the so-called 'process induction', which describes the process of drawing on evidence from desk reviews to reconstruct the steps that allow the cadre to conduct a higher-quality initial assessment (e.g. a mobile phone-guided assessment may be more comprehensive). Based on these reconstructions, a number of hypothetical causal mechanisms that explain how the mobile phone technology may improve the initial assessment will be developed. The reconstruction will also build on and extend the Theory of Change for the nutrition-counselling component described in Figure 3.2.

Using data collected in direct observation of the counselling process and during in-depth interviews with cadres and caregivers (see above), these hypotheses will be tested and the actual causal links will be identified. This will facilitate learning about the detailed features of the application and its potential added value to the counselling process. The evaluator aims to identify 'traces' of this added value while observing the process or interviewing the cadres. The goal is to observe improvements that are specific enough to the application to seem realistically impossible to obtain through any other causal factor (e.g. because without the mobile phone application it is impossible to remember all components of the assessment). This does not mean that if these improvements are not observed, then the application failed to improve the counselling process: it just means that, when they are observed, they prove that the application had a specific role.

In the last step of the process tracing (the 'process verification'), the observed evidence and the causal chain models developed based on it are compared with the hypothetical chain models developed in the process induction. Van Evera (1997) and Bennett (2010) introduced four tests that can be used for the comparison, based on whether the evidence passes certain criteria for necessity and sufficiency to confirm or disconfirm a causal link (the 'straw-in-the wind', the 'hoop test', the 'smoking gun' and the 'doubly decisive test') (see Appendix D for further details based on Collier (2011)). In particular, if the improvement is found to be specific enough to the application ('unique'), the evidence could pass the 'smoking gun' test (Van Evera *op. cit.*; Bennett *op. cit.*; Beach and Pedersen 2012), which attributes causality.

ii. Analysis of information

For the evaluation of the impact of the mobile phone application on (ii) the analysis of the information and the identification of household-specific challenges to child feeding and care

[15] Small n impact evaluations are impact evaluation with a small sample size.

practices, a similar approach to the one described in (i) above will be used. The UNICEF guidelines recommend three criteria for the assessment of cadres' performance in the analysis stage of the home-based nutrition counselling (Appendix C). These include:

- Cadre considers deviation from the age-appropriate recommended practices for child feeding and care.
- Cadre considers special issues and barriers to adequate child feeding highlighted by the mother/caregivers in the initial assessment.
- Cadre correctly prioritises the most important issue for action.

As above, comparison of the features of the mobile phone application with the three criteria recommended by UNICEF, direct observations and comparison of the analysis procedures with and without mobile phone and in-depth interviews with the cadres and caregivers will be used to assess the impact of the mobile phone on the analysis. Process tracing will be used to further unpack the causal chains and mechanisms between the use of the mobile phone and the outcomes of the analysis of the information collected in the initial assessment.

iii. Provision of tailored messages and advice

The evaluation of the impact of the mobile phone on the provision of tailored behaviour-change messages to the caregiver will follow the same principles as (i) and (ii). First, the features of the mobile phone application will be compared with the six criteria for the third step of home-based counselling recommended by UNICEF ('act'). The criteria include whether the cadre praised the caregiver for positive practices, addressed the reasons for difficulties identified in the initial assessment, provided and discussed relevant information on childcare practices, helped the caregiver to solve problems, encouraged caregivers to try new practices and agreed upon practices. Direct observation and comparison of the counselling procedures and in-depth interviews with cadres and caregivers will provide further insights into the impact of the mobile technology. The evaluation team initially considered administration of a survey on nutrition- and childcare-related practices to the caregiver before and after the counselling session. However, as the counselling aims to provide specific and highly relevant information rather than to increase the caregiver's general knowledge of nutrition, this idea was not pursued further.

There are a few additional challenges that make the evaluation of this sub-component (iii) more complex and delicate. On one hand, the application could make the cadre more confident that s/he is providing the right behaviour-change message and so improve the clarity of the message. One the other hand, this could make cadres overconfident, condescending and even patronising (unintended consequences). Cadres may use their negotiating skills less and become more directive in their behaviour-change counselling. This might make mothers defensive and less willing to take up and follow the cadres' suggestions. One could speculate that the influence of the mobile phone application on the behaviour-change counselling process may vary and depend on the different contextual conditions (e.g. characteristics of the cadre and the caregiver, setting of the counselling). Careful contextual analysis will therefore complement this evaluation component (if resources permit, a realist evaluation approach might additionally be employed).

8 Data collection and analysis

8.1 Development and overview of data collection methods

Data collection tools will be developed in the inception phase of this pilot and evaluation study. Table 8.1 provides an overview of each method and the types of measure it will yield.

Table 8.1 Data collection methods and measures

Data collection method		Measure
Formative phase		
	Semi-structured context protocol	Contextual factors that may interact with the outcomes (e.g. network coverage, access to electricity, characteristics of cadres, workflow in posyandu, environmental conditions)
	Semi-structured interviews with cadres and caregivers	Acceptability of the mobile phone application, perceived barriers, facilitators and opportunities for the use of the mobile phone application
	Focus groups with cadres	Perceived barriers, facilitators and opportunities for the use of the mobile phone application
	Participant observations with diary	Functionality of mobile phone application, perceived barriers, facilitators and opportunities for the use of the mobile phone application
Growth monitoring		
	Individual and aggregated growth-monitoring data (paper-based and mobile phone-based)	Comparison of outcome indicators on accuracy (e.g. consistency in anthropometric data, nutritional status and growth velocity, total number of moderately/severely undernourished children per posyandu) between paper-based records (e.g. registration book in posyandu, temporary paper slips, aggregated summary reports) with mobile phone-based records
	Aggregated growth mentoring data and manual records of data submission	Lag-time of data submission to midwife, health authorities and other stakeholders
	Direct observation with structured observation protocol	Real-time behaviour measure of cadres (e.g. number of cadres with and without mobile phone who give feedback and arrange home visits; observed interaction between cadres)
	Survey with caregivers	Number of caregivers who receive feedback, get appointment for home-visit with/without mobile phone Perspective on the use of mobile phone technology for growth monitoring
	Growth-monitoring data	Number of children followed-up with home visit with/without mobile phone
	In-depth interviews with cadres	Perspective and practice of feedback provision and arrangement of home visits with/without mobile phone
	Political economy analysis and stakeholder interviews	Perspective of relevant stakeholders on contextual factors, dynamics that may enable or hinder uptake of growth-monitoring data Understanding of nutrition-related decision-making processes in Indonesia
Nutrition counselling		
	Direct observation	Comparison of mobile phone features with observations of the counselling practices based on appraisal criteria checklist for IYCF
	In-depth interviews with cadres and caregivers	Perspective of nutrition counselling with mobile phone application

8.2 Data analysis

The final analysis of the evaluation data at the end of data collection will consist of separate analyses for each study component (i.e. formative phase, growth monitoring, nutrition counselling and stakeholder responsiveness to mobile phone data). Analysis will be conducted at posyandu-level and for some variables aggregated analysis will be carried out. For each component, triangulation of the different quantitative and qualitative data with contextual information will take place in order to understand differences in performance of the mobile phone application in different settings. Quantitative data analysis will be done using Stata software and qualitative data will be managed using NVivo.

8.3 Ethics

Ethical approval will be sought via the Indonesia Ministry of Research and Technology and the IDS ethical board. The application for foreign research permits for the IDS team is currently under review by the Ministry of Research and Technology.

In the posyandus, informed consent will be taken from all cadres participating in this study and the caregivers who bring the child/ren to the posyandu.

All data sets from the growth-monitoring and the nutrition-counselling activities will be fully anonymous and thus cannot be linked back to the individual child. All data will be stored on a secure server and access to the data will be password protected and will only be given to authorised researchers for the purposes of description and analysis.

9 Suggestions for additional evaluation approaches

9.1 Cost-benefit analysis of the mobile-phone solution

Monthly data collection and processing as part of community-based growth monitoring can be costly and a major barrier for sustainable systems (Shoham and Watson *op.cit*.; Ashworth *et al. op.cit*.). The application of mobile phone technology can potentially reduce the costs related to manual data collection, entry and transfer. However, our initial evidence review suggests that the upfront costs (e.g. initial costs for the procurement of mobile phones, development and modification of the software application) and ongoing costs (e.g. server maintenance, refresher training, technical support) of mobile phone-based surveillance systems can be substantial (Barnett and Gallegos *op.cit*.). By contrast, given that growth monitoring in the posyandus is conducted by unpaid volunteers and transport costs are minimal, monetary costs of the current system are very small.

However, in a cost-effectiveness analysis the benefits do not (necessarily) need to be financial, but can also be based on broader social benefits – e.g. the social value of better nourished children due to early detection of undernutrition and better nutrition counselling; the long-term value of a better-nourished, more productive society (Tan-Torres Edejer *et al.* 2003; Bamberger, Rugh and Mabry 2012). Cost-effectiveness could be assessed by comparing the costs and benefits of the mobile phone-based system with comparable systems and nutrition data collection activities.

10 Potential challenges and mitigation strategies

10.1 Logistical and operational challenges

Cadres may discontinue the use of the mobile phone technology during the pilot study. Reasons for the discontinuation may include: thefts, broken phones, problems with software or hardware, temporary lack of electricity to charge phones, misuse of the phone (e.g. for private calls), if the mobile application is not perceived as useful or becomes an additional burden during busy posyandu activities.

Ongoing technical support provided to the pilot posyandus by district-level World Vision staff (i.e. the m-health support officer) aims to reduce the risk of discontinuation. The initial formative phase seeks to identify and address posyandu-specific logistic and operational challenges.

Another challenge may be the high drop-out rates among the cadres. To avoid disruption of the pilot and evaluation study by the departure of cadres who were trained on the use of the mobile application, several cadres from the same posyandu will be trained simultaneously and will also rotate duties in monthly posyandus.

10.2 Methodological challenges

Indonesia is regularly affected by natural disasters (see 6.3.1) that may affect posyandu activities for longer periods of time during the evaluation. For example, one of the urban study posyandus had to be closed due to flooding for two months last year. As this evaluation uses individual-level growth-monitoring data (per child/month/posyandu) and also employs a case-study approach, the validity of the results would not be affected.

10.3 Data-related challenges

Poor quality of the data collected as part of this evaluation (e.g. during in-depth interviews, focus group discussions, observations) can reduce the value of the analysis. Potential threats to data quality could be response bias or interviewer bias. Measures to ensure high-quality data will include: use of experienced staff, careful training and regular refresher training, pilot-testing of all data collection tools and modification, if necessary.

10.4 Unintended consequences

The mobile phone application may change the dynamics and underlying existing hierarchy between the cadres (e.g. older cadres may feel less comfortable with the technology). The formative phase aims to reveal and address potential tensions caused by the introduction of the mobile phone application in the posyandus.

Another possible scenario could be that cadres' new technology skills may improve their confidence and employability and as a consequence they may decide to leave. As described in 10.1, several cadres will be trained on the mobile phone application to avoid disruption of the pilot in case of drop-out.

11 Conclusions

This study sets out to develop and describe the design of a scientifically robust evaluation of the impact of a mobile-phone application on growth monitoring and nutrition counselling in posyandus in rural and urban Indonesia. In contrast to the small number of existing studies, in this study the mobile phone application will be integrated into the existing national system for nutrition service delivery in Indonesia. Integration into existing national nutrition programmes and systems is a key factor for sustainability and potential scale-up. The evaluation team chose the evaluation design and approaches based on careful analysis of contextual factors and considerations. The resulting evaluation design draws on several innovative evaluation approaches (i.e. Mill's method of difference, realist evaluation, process tracing and political economy analysis) to rigorously evaluate the impact of mobile phone technology on the accuracy and timeliness of and real-time responsiveness to growth monitoring and the quality of nutrition counselling.

Appendix A: Skills for home-based nutrition-counselling session (UNICEF 2013a)

Positive counselling skills

This set of cards was developed for you to help counsel mothers and other caregivers about infant and young child feeding (IYCF). Positive counselling skills are important for your success. Some basic counseling skills presented below include Listening and Learning, as well as Building Confidence and Giving Support.

Listening and Learning skills

- Use helpful non-verbal communication:
- Keep your head level with the mother (or caregiver)
- Pay attention
- Reduce physical barriers
- Take time
- Touch appropriately
- Ask open questions
- Use responses and gestures that show interest
- Reflect back what the mother (or caregiver) says
- Avoid using "judging" words

Building Confidence and Giving Support skills

1. Accept what a mother (or caregiver) thinks and feels. Let the mother (or caregiver) talk through her or his concerns before correcting any wrong ideas or mis-information. This helps to establish confidence.
2. Listen carefully to the mother's (or caregiver's) concerns.
3. Recognize and praise what a mother (or caregiver) and child are doing correctly.
4. Give practical help.
5. Give a little, relevant information at a time.
6. Use simple language that the mother or caregiver will understand.
7. Use appropriate Counselling Card(s) or Take-Home Brochure(s).
8. Make one or two suggestions, not commands

IYCF 3-Counselling:

The following 3-Step Counseling will help you to counsel, with mothers (or caregiver) about infant and young child feeding. The 3-Steps are Assess, Analyze and Act.

Step 1: Assess: ask, listen and observe

- Greet the mother (or caregiver), using friendly language and gestures.
- Ask some initial questions that encourage her (or him) to talk.
- Listen to what is being said and observe what is going on using your Listening and Learning, and Building Confidence and Giving Support skills.
- Assess the age appropriate feeding practice(s) and the condition or health of the child and mother (or caregiver).

Step 2: Analyze: identify difficulty and if there is more than one – prioritize the difficulties

- Decide if the feeding you observe is age-appropriate and if the condition or health of the child and mother (or caregiver) is good.
- If there are no apparent difficulties, praise the mother (or caregiver) and focus on providing information needed for the next stage of the child's development.
- If one or more feeding difficulty is present, or the condition or health of the child or mother (or caregiver) is poor, prioritize the difficulties.
- Answer the mother's (or caregiver's) questions if any.

Step 3: Act: discuss, suggest a small amount of relevant information, agree on doable action

- Depending on the factors analyzed above, select a small amount of information to share with the mother or caregiver that is most relevant to her or his situation.
- Be sure to praise the mother or caregiver for what she or he is doing well.
- Present options for addressing the feeding difficulty or condition of health of the child or caregiver in terms of small do-able actions. These actions should be time-bound (within the next few days or weeks).
- Share key information with the mother or caregiver, using the appropriate Counselling Cards or Take-home Brochures and answering questions as needed.
- Help the mother or caregiver select one option that she or he agrees to try, in order to address or overcome the difficulty or condition that has been identified. This is called reaching-an-agreement.
- Suggest where the mother or caregiver can find additional support. Refer to the nearest health facility if appropriate and/or encourage participation in educational talks or IYCF Support Groups in the community.
- Confirm that the mother or caregiver knows where to find a community volunteer and/or other health worker.
- Thank the mother or caregiver for her or his time.
- Agree on when you will meet again, if appropriate.

Appendix B: Initial assessment of infant and young child feeding practices (UNICEF 2013a)

Name of Mother/ Father/Caregiver		**Name of Child**		**Age of child (completed months)**		**Number of older children**
Observation of mother/caregiver						
	Child Illness	Child sick		Child not sick		Child recovering
	Growth Curve Increasing	Yes		No		Levelling off/Static
Tell me about breastfeeding		Currently breastfeeding	If No: when did BF stop?	Yes	Frequency: times/day & night	How is breastfeeding going (record any difficulties)?
Tell me about any liquids your child receives		Is your child getting anything else to drink?	What	Frequency: times/day	Amount: how much (Ref. 250 ml)	Bottle Use? Yes/No
	Other milks					
	Other liquids					
Tell me about complementary foods		Is your child getting anything else to eat?	What	Frequency: times/day	Amount: how much (Ref. 250 ml)	Texture: how thick/ consistent
	Animal (meat/fish/ offal/bird/eggs/dairy (milk) products)					
	Legumes (beans, other local examples)					
	Vegetables/Fruits (local examples)					
	Staple (porridge, other local examples)					
Other challenges (note REASONS underlying challenges)						
	Mother/caregiver assists child	Who assists the child when eating?	Own plate?			
	Hygiene	Feeds baby using a clean cup and spoon	Washes hands with clean, safe water and soap before preparing food, before eating and before feeding young children			Washes child's hands with clean, safe water and soap before he or she eats

Source: UNICEF (2013a)

Appendix C: Checklist for the assessment of cadres performance during the initial assessment of infant and young child feeding practices (UNICEF 2013a)

Did the Community Worker …			**RECORD**		
SKILL # 1 INFANT AGE	N/A for this visit	Did not obtain information on infant age	Asked about infant age, but did not ask for confirming evidence	Asked about infant age and attempted confirmation from record or maternal report on date of birth	Comments/ Observations
Obtain correct infant age					
SCORE: SKILL #1 Sufficient = 1 Not sufficient = 0			SCORE #1		
Did the Community Worker …			**RECORD**		
SKILL #2 (IYCF 3-step counselling) STEP 1: ASSESS	N/A for this visit	Not done	Limited performance	Sufficient performance	Comments/ Observations
Assess breastfeeding (with mother)					
Assess the current breastfeeding status					
Check for breastfeeding difficulties					
Observe a breastfeed (if necessary)					
Assess use of infant feeding bottle					
Complementary feeding at appropriate age					
Assess ‘other food’ and ‘other fluid’ intake					
Assess AFATVRH					
Complete assessment before going on to Analyse or Act					
SCORE: SKILL #2 Sufficient = 1 Not sufficient = 0			SCORE #2		

(Cont’d.)

Appendix C (cont'd.)

Did the Community Worker …			**RECORD**		
SKILL #3 (IYCF 3-step counselling) STEP 2: ANALYSE	N/A for this visit	Not done	Limited performance	Sufficient performance	Comments/ Observations
Considered deviation from age-appropriate recommended practices					
Considered issues reported by mother					
Correctly prioritised the most important issues for action					
SCORE: SKILL #3 Sufficient = 1 Not sufficient = 0			SCORE #3		
Did the Community Worker …			**RECORD**		
SKILL #4 (IYCF 3-step counselling) STEP 3: ACT	N/A for this visit	Not done	Limited performance	Sufficient performance	Comments/ Observations
Praise the mother/ father/caregiver for positive practices					
If difficulty, address the reasons					
Discuss limited and relevant information					
Help mother problem-solve, as appropriate					
Encourage mother/ caregiver to try new practice					
Agree upon action					
SCORE: SKILL #4 Sufficient = 1 Not sufficient = 0			SCORE #4		

(Cont'd.)

Appendix C (cont'd.)

Did the Community Worker …			**RECORD**		
SKILL #5 APPROPRIATE USE OF MATERIALS	N/A for this visit	Not done	Limited performance	Sufficient performance	Comments/ Observations
Use of CCs to reinforce good breastfeeding practices:					
Point out characteristics of CF using appropriate CC for age group					
Use of CCs to reinforce good hygiene practices					
Show how to add micronutrient supplements for home fortification					
SCORE: SKILL #5 Sufficient = 1 Not sufficient = 0			SCORE #5		
Did the Community Worker …			**RECORD**		
SKILL #6 COMMUNICATION SKILLS	N/A for this visit	Not done	Limited performance	Sufficient performance	Comments/ Observations
Use Listening and Learning skills					
Use good non-verbal communication					
Ask questions that allow for detailed information					
Use Building Confidence and Giving Support skills					
Accept what mother/ father/caregiver thinks and feels					
Give practical help					
SCORE: SKILL #6 Sufficient = 1 Not sufficient = 0			SCORE #6		
TOTAL SCORE			__ (of 6 possible points)		

Source: UNICEF (2013a)

Appendix D: Causal inference tests for process tracing

		Sufficient for affirming causal inference	
		No	Yes
Necessary for affirming causal inference	No	**1. Straw-in-the-Wind**	**3. Smoking-Gun**
		a. Passing: Affirms relevance of hypothesis, but does not confirm it.	**a. Passing:** Confirms hypothesis.
		b. Failing: Hypothesis is not eliminated, but is slightly weakened.	**b. Failing:** Hypothesis is not eliminated, but is somewhat weakened.
		c. Implications for rival hypotheses: **Passing** *slightly* weakens them. **Failing** *slightly* strengthens them.	**c. Implications for rival hypotheses:** **Passing** *substantially* weakens them. **Failing** *somewhat* strengthens them.
	Yes	**2. Hoop**	**4. Doubly Decisive**
		a. Passing: Affirms relevance of hypothesis, but does not confirm it.	**a. Passing:** Confirms hypothesis and eliminates others
		b. Failing: Eliminates hypothesis.	**b. Failing:** Eliminates hypothesis.
		c. Implications for rival hypotheses: **Passing** *somewhat* weakens them. **Failing** *somewhat* strengthens them.	**c. Implications for rival hypotheses:** **Passing** *eliminates* them. **Failing** *substantially* strengthens them.

Source: Collier (2011).

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