SMS for Life in Burundi and Zimbabwe: A Comparative Evaluation

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Abstract. Several benefits of mobile health (mHealth) technologies have been documented in the literature. However, available literature is not as "extensive" as those in developed countries, particularly on implementation issues and challenges of mHealth interventions. This is worrying, as addressing the usefulness and appropriateness of a mHealth program before implementation is essential. This paper comparatively assessed the ease and appropriateness of implementing a Short Messaging Service (SMS)-based mHealth technology in developing countries of similar settings. The framework of Marshall, Lewis and Whittaker, based on the Bridges' criteria, was chosen for the comparison. It was found that Burundi has many challenges that need to be addressed first before implementing a mHealth intervention. Zimbabwe enjoys a better funding model with more 'experience' in eHealth projects and initiatives, and a successful mHealth intervention is more plausible. This paper highlights the importance of critically assessing the mHealth intervention and the target community before implementation.

Keywords: *SMS for Life*, Bridges' criterion, mHealth evaluation, eHealth evaluation, mHealth implementation, eHealth implementation, mHealth Africa, mHealth Burundi, mHealth Zimbabwe, mHealth Malaria

1   Introduction

Disease burden in developing countries are high [37] due to limited resources and infrastructure [3, 5, 37] and lack of medical expertise, technology and corresponding technical support [5]. This leads to health services being focused on urban areas [37].

Mobile health (mHealth) is the use of mobile technologies to support healthcare [37], and can be described as eHealth with a particular focus on mobile technologies. mHealth is useful in "removing physical barriers to care and service delivery and by improving weak health system management, unreliable supply systems, and poor communication" [37].

Mobile health is increasing in viability because of the rising ubiquitousness of mobile phones. Mobile phones are 'everywhere' [24, 37], sometimes more than other basics such as clean water [11]. This highlights the potential that mHealth has in developing countries.

Several benefits of mHealth in developing countries have been documented, and there are evidence of successes [11].

However, despite the increase in mHealth applications and projects, there is still a relative dearth of literature in the area. The literature of mHealth in developing countries are particularly not as "extensive" as those in developed countries [5]. There are "minimal formal evaluation of mHealth" [37] and limited evidence of its successes beyond the pilot stage [11, 24]. In fact, about two-thirds of mHealth implementations are only pilot studies [24]. It is clear that any implementation of mHealth have to be carefully evaluated, as the success stories are mostly in their infancy.

There is also a lack of frameworks for implementation of mHealth technologies [23], and correspondingly, literature on the implementation of a mHealth intervention. This is unfortunate as it is important to clearly identify the challenges faced by health stakeholders in developing countries; unique as they are in different countries and different areas within those countries. "Forms and related practices" vary "because of different or very different situations" [27].

2 Objectives

This paper will assess the ease and appropriateness of implementing *SMS for Life*, a Short Messaging Service (SMS)-based mHealth technology for developing countries of similar settings: Burundi and Zimbabwe.

There is a need to address the usefulness and appropriateness of a mHealth program before implementation [23, 24]. It is important to assess implementaions prior to execution in order to address challenges that relate to "people, process, technology, mobile devices, computing standard, security and privacy and electromagnetic conformity" [24]. This is especially true in developing countries, which often are not able to develop the technology needed themselves, and therefore rely on the proper selection of the best suited technology to quickly "achieve economic and social development goals" [5]. Developing countries have a low tolerance for failure or instability [20].

SMS for Life is a collaboration between public and private partners, led by Novartis, an international pharmaceutical company. It is listed as an initiative of the global Roll Back Malaria Partnership. It seeks to solve problems related to malaria medicine distribution, and uses "mobile phones, SMS messages, the Internet and electronic mapping technology" for tracking medicine stocks in health facilities [26, 29] "to: Eliminate stock-outs, increase access to essential medicines, reduce the number of deaths from malaria" [26].

SMS for Life has been chosen as a focus because of documented successes, and/or strong partnerships for implementation gained with government and/or non-

governmental agencies, in Tanzania, Ghana, Kenya, Cameroon and the Democratic Republic of Congo [26].

The two (2) countries included in this comparative evaluation are Burundi and Zimbabwe. Burundi and Zimbabwe are the top two (2) countries in Africa with the highest cases of Malaria; in fact Burundi is top one (1) in the world, with Zimbabwe as third [35]. Moreover, they are also the two countries with the lowest GDP in Sub-Saharan Africa [27].

3 Methodology

3.1 Evaluation Framework

There were four frameworks analysed for appropriateness to meet the objectives of this paper.

- Mburu, Franz, and Springer (2013, July) developed a 'Conceptual framework for designing mHealth solutions for developing countries'. Its main focus however is to determine the potential usefulness of a mHealth intervention, and not on the ease of implementation.
- The paper of Wall, Vallières, McAuliffe, Lewis, and Hederman (2014) entitled 'Implementing mHealth in Low-and Middle-Income Countries: What Should Program Implementers Consider?' focused on practical considerations of implementing mHealth. Although it is a useful reference, it is not really a framework.
- Chan and Kaufman (2010) developed a 'technology selection framework for supporting delivery of patient-oriented health interventions in developing countries'. It is a good framework that would do well as a guide to selecting the type of technology that would fit a health problem in developing countries. It takes into account social and cognitive sciences. However, it is slightly broader and is more appropriate for determining the category of technology appropriate, and does not focus too much on specific implementation issues.

The chosen framework is the work of Marshall, Lewis and Whittaker (2013). Their paper entitled 'mHealth technologies in developing countries: a feasibility assessment and a proposed framework' presents a framework based on the Bridges' criteria that evaluates the "appropriateness of mHealth technologies, in the context to which they are being proposed". It is a comprehensive framework that takes into account the technical, political, economical and social factors that would impact the ease and effectiveness of eHealth interventions.

The framework is divided into twelve (12) main categories. The descriptions and importance of each category is described in the findings section, alongside relevant comparative data gathered for *SMS for Life,* Burundi and Zimbabwe. The descriptions have been edited to make them more concise for the purposes of this paper, than was originally presented in the paper of Marshall, Lewis and Whittaker (2013).

3.2 Search Strategy

To search for the appropriate evaluation framework, the following keywords were used: 'mHealth', 'eHealth', 'developing countries', 'evaluation framework', and 'implementation'. The words were combined several times; 'mHealth' and 'eHealth' were interchanged and combined, while 'developing countries' was always used.

To search for eHealth applications related to Burundi and Zimbabwe, the following general search terms were used: 'eHealth', 'mHealth', 'mobile health', and 'malaria'. They were interchanged and combined with the specific terms 'Burundi' or 'Zimbabwe' during the search. Links and information offered/mentioned by the results of the search were also followed.

The search resulted in many examples of eHealth applications implemented in Burundi, Zimbabwe, or more generally in Sub-Saharan Africa, Africa or developing countries. However, most did not discuss implementation issues. To gather data relevant for Category-specific terms, other search terms were used. The search terms were 'mobile phone', 'access', and 'implementation'; and combined with 'Burundi' or 'Zimbabwe'. The search results provided a lot of information regarding the socio-cultural, political and mobile phone access of Burundi and Zimbabwe.

The Global Observatory for eHealth and Global Health Observatory webpages of the World Health Organization, which include country fact sheets, were also used as a source of reference. Data and information from the websites of World Bank and the International Telecommunications Union were also used. These provided country- and region-specific information relating to health (i.e., malaria) status, eHealth policies, mobile phone activity, and GDP, among other things.

To search for information related to the features, application and corresponding results of *SMS for Life*, the websites of Novartis – *SMS for Life* [26] and Roll Back Malaria – *SMS for Life* [29] initiatives were investigated for information and leads to conferences, reports and/or research papers. The website of Greenmash, the company behind the platform used by *SMS for Life*, was also used as a source.

Moreover, the term '*SMS for Life*' was used as a search term for PubMed, Biomed Central and Google Scholar. The previous search results for the evaluation framework, Burundi and Zimbabwe were also investigated for information leads on *SMS for Life*.

Lastly, only English-written papers were considered.

4 Results and Findings

Table 1 outlined in the next pages present the findings as mapped to the framework used.

Table 1. Evaluation of the ease of implementation of SMS for Life in Burundi and Zimbabwe, based on the framework of Marshall, Lewis and Whittaker (2013)		
Bridges Criterion	Burundi	Zimbabwe
Criterion 1: Physical access to mobile technology Is the mobile technology available and accessible by target populations and field workers? Consider the: • availability of infrastructure, such as mobile networks • existence of barriers (e.g. poor signal coverage) • accessibility of the mobile phones themselves, particularly to disadvantaged populations.	• Mobile subscriptions at 24.96% [13]. • Burundi reports that underdeveloped infrastructure **is not** a barrier to mHealth [36]. • A member of the International Medical Informatics Association, which "promotes the effective use of informatics within healthcare, the dissemination of knowledge and health informatics education, and translation of research into practice" [28]. BOTH (Burundi and Zimbabwe): Fluctuating network and electricity coverage were common problems of mobile data surveillance. Some solutions identified were recording of information via paper then sending later on [1].	• 96.35% mobile subscriptions [13]. • 12% have access to the Internet, and mobile phone communications rate at 78.5%. However, there is load shedding as long as 8 hours/day every day [38]. • Zimbabwe reports that underdeveloped infrastructure **is** a barrier to mHealth [36]. • There is a lack of national/international standards use for interoperability [38]. • Has Observer membership with the ISO technical committee 215 (ISO TC 215) [28], which works on standardization in health informatics (International Standards Organization) [12].
Criterion 2: Appropriateness of mobile technology We must now examine whether the chosen mHealth program is suitable to local needs. Undertake a more technical evaluation of the mobile technology: • What is its capacity? • What operating system does it require (this is particularly relevant to smartphones and PDAs)? • Is it a user-friendly application, or will people need significant training? • Can it be translated into appropriate local languages, or is it only available in English? Will the target population be able to read and understand the messages they receive? • Will the mobile technology function independently, or will it require a comprehensive (i.e. expensive) supporting network of computers and other ICT measures? • What energy sources are required? For example, can mobile phones easily be charged? • Are there cheaper / simpler options available that will provide the same function?	BOTH: • *SMS for Life* uses the Mango platform by Greenmash (http://www.greenmash.com/). The platform has three plans. The Basic plan allows only a maximum of ten (10) users per month. Standard allows for an average of ten (10) to two hundred (200) users. Finally, Enterprise allows an average of more than one thousand (1,000) users per month [9]. • Mango works on 'smart' devices, basic handsets such as the old Nokia phones, web forms, and other complementary systems [9]. • Health workers who would use the system to send stock reports attended only one-day trainings, which was deemed to be sufficient and produced effective results [8]; indicative of the ease of use of the system. District health officers were also given a half-day training on how to view the system, along with coaching on supporting health workers [2]. • The health workers need to use specific, simple codes in sending stock count messages. The codes are A = AL 6, B = AL 12, C = AL 18, D = AL 24 and T = RDT; which are then to be followed by the number of those specific stocks left. • The system has only two (2) components, basic mobile phones and at least one (1) Internet-enabled PC in the national/regional health district [26]. • The proliferation of mobile devices in both Burundi and Zimbabwe are indicative of the feasibility of charging the phones. The pilot tests in the five countries mentioned in the introduction aid in this assumption. Moreover, health workers used their own mobile phones and numbers – which means that they already had phones and were using them, prior to the project being implemented [2, 8]. • High weekly response rates so far (97%), low formatting error rates (3%) and good accuracy of stock counts (79%) and stock outs (93%) [8]. • Other SMS-based eHealth initiatives have been implemented before, including one in Zambia which tracked malarial diagnoses; however *SMS for Life* is the first to track stock levels locally [2].	
Criterion 3: Affordability of mobile technology and technology use • Can we afford it? • Start-up costs may be significant, but do costs remain high over the long term? • Is the technology expected to become widely used,	BOTH: • Basic, cheap phones will do [2, 9]. • Many projects did not continue or never scaled because of lack of sustainable funding [1]. • A survey conducted on public health professionals from developing countries including Southern Afri-	• Duty free importation of ICT tools present [38]. • Informal economy with regards to sale of prepaid phones, trading and rental of mobile phones and so on shows affordability; and even helps the economy [7]. • However, Zimbabwe reports that perceived high costs of mHealth technologies **is** considered a barri-

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mass produced and, therefore, cheaper and more affordable for the local population?	ca indicated that lack of funds for credit purchase can serve as a challenge for mobile health [22]. • However, Burundi reports that perceived high costs of mHealth technologies **is not** a barrier [36]. • This is not really an issue: the stock messages could be sent by the health workers to the designated number free of charge [2].	er to mHealth [36].
Criterion 4: Human capacity and training Consider people's capacity for understanding and using the mobile technology: Who will be using the mHealth program? • Will it be used only by healthcare workers, or will the general public also use it? • At this stage, it is important to examine the technical and literary capacities of the target user population. • Will the program require a technical expert and frequent IT support or will the program be relatively self-sustaining? • Are training programs available, or will they need to be created?	• Students in health sciences are given ICT training at tertiary institutions, however, lack of knowledge of applications and technical expertise were considered a barrier to implementing mHealth initiatives [36]. BOTH: • Only health workers use the system [2, 8, 26]. • The short time of training needed [2, 8] and simple codes required [2] make it feasibly easy to use. • Difficulties recorded of keeping health staff motivated because of the additional work burden [1].	• 'Best' with good skills are leaving the country [38]. • Increase in banking transactions when SMS banking were introduced in Zimbabwe [32] may be indicative of literacy. • Students in health sciences are given ICT training at tertiary institutions. Moreover, institutions also offer continuing education in ICT for health professionals, and lack of knowledge of applications nor technical expertise were not considered a barrier to implementing mHealth initiatives [36].
Criterion 5: Locally relevant content, applications, and services • Does the program come with pre-packaged messages and/or questions that may not be locally relevant? • Is there opportunity to edit and adapt messages and/or questions to local customs and needs?	BOTH: The program requires the use of structured codes; however they are simple to learn and use [2].	
Criterion 6: Integration into daily routines It is important to consider how the chosen technology will integrate into the daily lives of its users: • Will it take a lot of extra time to use or complete? • Will it require travel to an inconvenient location?	BOTH: A maximum of two (2) to three (3) hours' walk to get a network coverage (in areas with low or no coverage) was observed as "acceptable", although a fifteen- (15) to thirty- (30) minute walk would be best [2]. Aside from that, it does not take too much time to count the stocks and send the message.	
Criterion 7: Socio-cultural factors Implementation of mobile technology can be impeded by socio-cultural factors if the local cultural context has not been properly evaluated. Some things to consider: • Are women allowed to carry mobile phones? • What is the interest level of the elderly? Are they generally considered too old to be included? • Will the mobile technology only be accessible by richer populations (e.g. people with smartphones)?	• It appears that sex is not a determining factor of involvement in e-learning activities. However, younger people are more active [4]. BOTH: • Mobile phones are an "aspirational status symbol within affordable reach" [34]. • Rapid growth of mobile phones in developing countries are "egalitarian" [15].	BOTH: • Preliminary evidence of mobile phones being gender neutral in Africa [19]. • Mobile phones shows some "optimism" of increas-

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• What can program/policy managers do to overcome these restrictions and avoid discrimination? • Is there room to communicate with political and religious leaders to aid in implementation?		ing women's empowerment in developing countries [14].
Criterion 8: Trust in mobile technology When addressing this criterion, it is important to understand people's historical use and experience with data collection and technology. • What is the level of confidence in mobile networks and existing mHealth programs? • What does the target population know about data sharing and technology issues? • What can program/policy leaders do to build people's trust in the project?	• Some eHealth implementations in Burundi include a mobile technology for disease surveillance [25] and the biggest community of open source hospital management information flow software OpenClinic GA [18]. However, focus are on effectiveness, (which are positive) and not implementation. • However, in a survey of key European ESTHER Alliance partners from Francophone Africa, which included Burundi, 64% reported never having any involvement in e-learning activities [4]. • Burundi's reports that there are no mHealth project initiatives [36]. What 'initiatives' mean are not clear however; perhaps it means initiatives by Burundi's government, and not from outside agencies/groups. • Laws for privacy of personally identifiable data present; but no laws specifically for EMR/EHRs [36].	• Some eHealth implementations in Zimbabwe include the District Health Information System (DHIS), which captures data from all 67 districts in the country and supported by mobile apps; also, the Human Resource Information Systems to track human resources for health [38]. • WHO notes Zimbabwe's claim of existence of mHealth project initiatives, but no formal evaluation or publication exists [36]. What 'initiatives' mean are not clear however; perhaps it means initiatives by Zimbabwe's government, and not from outside agencies/groups. BOTH: Mandatory registration of mobile numbers will increase privacy concerns and fear. There are also "insufficient data protection rules" [16].
Criterion 9: Local economic environment Relating to criterion 3 (affordability), it is important to consider the appropriateness of the technology in the local economic context. • Is the economy in a state of growth? What is the cost of mobile phone handsets, mobile phone calls, and/or SMS? • Is the economy expected to grow? • Will the new technology assist in creating new jobs, facilitate economic growth by streamlining processes, and encourage mobile technology uptake in the community? Or will it replace jobs, thereby creating unemployment and distrust in the program?	• Burundi has a mixed financing model for health. Most of its funds come from international donors, and it has strong private-oriented practices. This means that it receives a high level of international support. Although this sounds good on the surface, it lends to problems; rendering "the identification of functioning modes difficult. The existence of a plethora of donors weakens health system's coordination, and characterizing funding modes in such situations is almost impossible." [27]. • Burundi is therefore categorised as having a Low Human Development Index, for the reasons mentioned above [27]. • Burundi's GDP growth is expected to decline from 4.0% this year to 3.0% in 2016 [31]. • Contribution of mobile telecommunications to annual GDP of Burundi is 0.12%. As a comparison, the average of high income countries is 0.20% [10].	• Zimbabwe is categorised as having a High Human Development Index as its health financing model, a mix of national funds and strong private-oriented practices [27], allows for better coordination. • Zimbabwe's GDP growth is expected to decline from 2.0% this year to 0.6% in 2016 [31]. • Contribution of mobile telecommunications to annual GDP of Zimbabwe is 0.091%. The average of high income countries is 0.20% [10]. • A thriving informal economy, particularly in the sale of mobile phone cards, served as a "coping strategy" for Zimbabwe's "various crises" [7]. BOTH: • Positive correlation of mobile technology with economic growth can be deduced [21]. • Prepaid system matches Sub-Saharan Africa's economic situation "perfectly." There are also indications some evidences that it helps revitalise their economy [19], reduce price disparities of products in the market (through price information sharing) and grow their GDP [30].

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Criterion 10: Macro-economic environment In the same way that it is important to understand the political and cultural factors impacting technology uptake, we must examine the national economic environment of the country. • What are the taxation policies? • Do policies support technology use?	• WHO's Global Observatory for eHealth [36] noted that Burundi has a National eGovernment policy, a National eHealth Policy and a National ICT procurement policy for the health sector. However, upon checking, none of the policies could be found in the Directory of eHealth policies in the same page. Neither can such policies be found in government websites [4]. • Lack of policy frameworks is considered a barrier to mHealth implementation [36].	• Zimbabwe has an eHealth Strategy (2012-2017) developed by Zimbabwe's Ministry of Health and Child Welfare that aims to "support, promote and advocate for the provision of quality and efficient health information technology in Zimbabwe, while maximising the use of available resources. A national ICT policy is already in place and efforts are being made to incorporate numerous sector-wide policies including eHealth" [36]. A draft can be found at the Directory of eHealth policies. • Has an existing national ICT policy according to the Zimbabwe Ministy of Health and Child Welfare (2012). However, in a World Health Organization (2014) report, the country responds that they do not. They are also noted to not have a national ICT procurement policy for the health sector. • Lack of policies for coordinated eHealth efforts exists. Lack of policy frameworks is considered a barrier for mHealth implementation [36].
Criterion 11: Legal and regulatory framework • Do current laws and policies promote or hinder the use of the mobile technology? Consider the legal responsibilities, and what implications the laws (or lack thereof) have for future liabilities.	• Lack of legal policies or regulation reported **as a** barrier [36]. BOTH: • Mandatory registration reduces the penetration growth of mobile subscriptions due to increase in cost, and difficulties in gathering sufficient identification information [16]. • Laws for privacy of personally identifiable data present; but no laws specifically for EMR/EHRs [36]. • No laws or policies present regarding sharing of health-related data between health care staff through EMR/EHR [36].	• Lack of legal policies or regulation **not considered** a barrier to mHealth [36].
Criterion 12: Political will and public support • It is important to assess whether the public supports the program and whether their preferences have been communicated to local government. • Opportunities for collaborating with stakeholders, and developing e-strategies and public-private partnerships to reduce operational costs should be examined.	• Top 2 lowest GDP in Sub-Saharan Africa, but not part of top ten lowest % GDP allocated to health [27]. There is demand for mHealth initiatives [36]. • For e-Learning activities, partnerships between local health institutions and national, African, American and European institutions are reported to be high in Francophone Africa [4]. 60% however, have not ben in direct contact with their partner colleagues.	• Top 1 lowest GDP in Sub-Saharan Africa, but % GDP allocated to health is higher than Congo, which is the richest among the group [27]. There is demand for mHealth initiatives [36]. • National ICT policy and National eHealth Strategy exists [36]. • Their National eHealth strategy notes that the government is seeking to increase collaboration through Public-Private Partnership initiatives [38].

5   Discussion and Conclusions

SMS for Life is a simple, effective and cheap eHealth tool. It matches the needs of developing countries in that they require only the most basic, cheapest technologies, and is easy to learn. It can be gathered that the difficulties of implementing it lies on the economic, political and infrastructure challenges of the country in which it will be implemented.

Implementing *SMS for Life* in Burundi presents several challenges. First of all, it requires that health workers use their own mobile phones. This is good in principle, as it ensures that it avoids the extra expense of buying mobile phones for health workers, thus making it more cost-effective to implement and feasible to scale-up. However, Burundi's mobile subscriptions is very low. This presents problems implementing the technology in a health facility with some, if not all, health workers not having their own phones. Buying phones for every health worker would be expensive. It may present more risks of incurring further costs if the phone is lost and/or stolen, and reduces the sense of ownership and responsibility of the device from the health worker. Moreover, if health workers without phones are given one, it might cause conflicts between them and those who were not given phones because they already have one. It might even lead to health workers pretending that they do not have phones.

The current structure of *SMS for Life*, which rewards health workers with a few cents' credit to send stock counts, is shown to be an effective motivation - even when some users need to walk for hours to send the stock count. It is not clear whether Burundi will be able to sustain it on their own, as most of their health funding comes from international donors, especially with the expected decline of their GDP growth. The fact that younger people are more active in eHealth might also be a cause for concern in health facilities where there are elderly health workers. They might not only have a hard time using the system, but may also feel left out. The simple codes use by *SMS for Life* gives hope that this will be a minimal issue, however.

There is no mention of *SMS for Life* using standards for interoperability with other systems. It may not be really relevant in Burundi as the use of standards is weak, however, it is important to assess the systems ability to interoperate when the need arises.

Implementing *SMS for Life* in Burundi will be met with many different challenges, and it seems that the country needs more assistance in the areas of economics, infrastructure and livelihood. It does have the highest cases of malaria, and so help is severely needed in fighting malaria, which *SMS for Life* does. Perhaps a compromise can be achieved - carefully implementing the intervention in the hardest-hit areas in Burundi, and in health facilities with workers who own mobile phones, and focusing more assistance in other areas. For this, however, strong private-public partnerships are required. International donors would have to keep communication lines open as much as possible, in order to deliver the most important interventions as soon as possible, and without duplicating efforts, and challenges.

Great care would also have to be taken when including elderly health workers. Their willingness to learn and use the messaging service will have to be assessed and addressed prior to implementation, and especially during training.

In Zimbabwe, the ease of implementation appears more promising, as they have very high mobile subscription rates and tax-free ICT importations. However, similar with Burundi, their infrastructure in terms of network and electricity coverage is not good. Be that as it may, they still enjoy more experience with eHealth projects and initiatives than Burundi. Their funding model is also better, as it is more dependent on public funds than external donors - indicative of a more stable financing model. Although the prospects of implementing *SMS for Life* and scaling it up later on is better in Zimbabwe, it must still be assessed whether the motivational structure of the intervention is feasible.

Literature on long-term, scaled-up implementations of *SMS for Life* in the five (5) countries it is in now are needed to determine whether the motivation persists through time and scope. Moreover, there might be issues related to the complete turn-over of the project to the health departments which are not yet known; the issues encountered after turn-overs are less known still. All these will be a good area of work and research in order to facilitate the implementations of the technology in other areas and countries.

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