Achieving sustainability and scale-up of mHealth interventions in sub-Saharan Africa: The views of policy-makers in Ghana

Daniel Opoku, MScPH; Reinhard Busse, Univ.-Prof., Dr. med., MPH; Wilm Quentin, PD, Dr. med., MSc HPPF

Department of Healthcare Management, Technische Universität Berlin, Berlin, Germany

Corresponding author:
Daniel Opoku, MScPH
Department of Healthcare Management
Technische Universität Berlin,
Straße des 17. Juni 135,
Sekretariat H80,
10623 Berlin,
Germany
Phone: +49 30 314 29222
Fax: +49 30 314 28433
Email: daniel.opoku@tu-berlin.de

Abstract

Background
A growing body of evidence shows that mHealth interventions may improve treatment and care for the rapidly rising number of patients with non-communicable diseases (NCD) in sub-Saharan Africa (SSA). A recent realist review developed a framework highlighting the influence of context factors, including predisposing characteristics, need, and enabling resources (PNE), for the long-term success of mHealth interventions. The views of policy-makers will ultimately determine implementation and scale-up of mHealth interventions in SSA. However, their views about necessary conditions for sustainability and scale-up remain unexplored.

Objectives
This study aimed to understand the views of policy-makers in Ghana with regard to the most important factors for successful implementation, sustainability and scale-up of mHealth NCD interventions.

Methods
Members of the technical working group responsible for Ghana’s national NCD policy were interviewed about their knowledge of and attitude towards mHealth, and about the most important factors contributing to long-term intervention success. Using qualitative methods and
applying a Qualitative Content Analysis (QCA) approach, answers were categorized according to the PNE framework into predisposing characteristics, need and enabling resources.

**Results**
19 policy-makers were contacted and 13 were interviewed. Interviewees had long-standing work experience of an average of 26 years and were actively involved in health policy-making in Ghana. They were well informed about the potential of mHealth, and they strongly supported mHealth expansion in the country. The PNE framework’s categories were useful for structuring the thinking of policy-makers about factors supporting the implementation of mHealth interventions. Policy-makers mentioned many factors described in the literature as important for mHealth implementation, sustainability and scale-up – but they focussed more on enabling resources than on predisposing characteristics and needs. Furthermore, they mentioned several factors that have been rather unexplored in the literature.

**Conclusions**
The study shows that the PNE framework is useful to guide policy-makers towards a more systematic assessment of context factors that support intervention implementation, sustainability and scale-up. Furthermore, the framework was refined by adding additional factors. Policy-makers may benefit from using the PNE framework at the various stages of mhealth implementation. Researchers may (and should) use the framework when investigating reasons for success (or failure) of interventions.

**Keywords**
implementation, sustainability, scale-up, mHealth interventions, eHealth, non-communicable diseases, disease management, sub-Saharan Africa, qualitative methods, health policy
Introduction
With the drastic decline of communicable, maternal and neonatal diseases as cause of death and burden of disease across the globe [1], and particularly in Africa [1, 2], the epidemiologic transition towards non-communicable diseases (NCDs) is in full swing. By 2030, 42% of all projected deaths in sub-Saharan Africa (SSA) will be caused by NCDs, which will then surpass communicable diseases as the leading cause of death in the sub-region [3, 4]. In some African countries such as Ghana, statistics show that already today about 42% of the total annual deaths are caused by NCDs, led by cardiovascular diseases [5–7].

At the same time, the use of mobile phones is continuously rising in the region with an estimated 77.8 per 100 inhabitants mobile-cellular telephone subscription rate in 2017 [8], thereby expanding the opportunities for the implementation of mobile phone-based health interventions (mHealth interventions) [9, 10]. Numerous studies and reviews have reported positive results of mHealth interventions against NCDs [11–15]. The World Health Organization (WHO) promotes the further development and more widespread use of mHealth interventions as part of its Global Action Plan for the prevention and control of NCDs [16] Yet, most mHealth interventions remain at the stage of pilot projects, and they are almost never scaled-up to entire countries [10, 13, 17–19].

In a recent realist review, Opoku et al. [20] developed a theoretical framework that aims to provide guidance to policy-makers and other decision-makers working on implementing, sustaining and scaling-up mHealth interventions for NCD management in SSA. The framework focuses attention on the influence of context factors, including predisposing characteristics, need, and enabling resources (PNE), for the long-term success of mHealth interventions. Therefore, we use the term mHealth PNE framework for the rest of the paper. The mHealth PNE framework is grounded in the experiences of patients and healthcare providers as reported in 20 studies of 18 mHealth interventions for NCDs [14, 21–39] conducted in 10 SSA countries. However, it remains unknown whether the factors that were described by patients and healthcare providers in these studies are in line with the views of policy-makers and other decision-makers about the most important conditions for implementation, sustainability and scale-up.

Ghana is one of the countries in SSA, where efforts to support the development of mHealth interventions have been most pronounced [40–43]. These efforts include the development of the Ghana eHealth strategy, which aims at supporting the improvement of the overall performance
of the health sector [42]. In addition, several mHealth interventions have been implemented, including the Millennium Villages Telemedicine project in the Amansie West district [44] and the Mobile Technology for Community Health programme in seven districts [45, 46]. As a result, policy-makers in Ghana can be expected to have considerable experience with mHealth interventions, and they are likely to have thought about factors that support intervention sustainability and scale-up.

The views of policy-makers and other decision-makers will ultimately determine the implementation, sustainability, and scale-up of mHealth interventions in SSA. In order to assure that the mHealth PNE framework is useful as a guide for policy-makers, it is important that the framework is sufficiently aligned with their thinking, i.e. policy-makers should find the categories of the framework useful when considering the most important factors for implementation, sustainability and scale-up. In addition, the experiences of policy-makers may provide additional insights about important factors contributing to a successful implementation, sustainability and scale-up of mHealth NCD interventions that might be missing in the existing literature [20].

Therefore, the aim of this study was to understand the views of policy-makers with regard to the most important factors that should be considered to assure successful implementation, sustainability and scale-up of mHealth NCD interventions, thus contributing to the improvement of the mHealth PNE framework. More specifically, the study sought to: (1) assess policy-makers’ knowledge of and attitude towards mHealth NCD interventions, (2) identify whether the categories of the framework are useful to structure the thinking of policy-makers, and (3) integrate the perspectives of policy-makers into the various components of the framework.

Methods
The study was conducted using qualitative methods (interviews) and applying a Qualitative Content Analysis (QCA) approach [47]. The manuscript was drafted following the Consolidated Criteria for Reporting Qualitative Studies (COREQ) [48].

Qualitative interviews
Guided by a semi-structured questionnaire (Appendix I), qualitative interviews were conducted by DO between November 2015 and January 2016 among stakeholders at health policy direction level who were actively involved in national health policy decision-making and implementation in Ghana. These one-to-one interviews lasted for an average of 45 minutes and were recorded for transcription and analysis. In addition, field notes were taken for purposes
such as capturing off-tape records and explaining why an interview might have been poorly conducted.

**Participants**
Participants were from diverse backgrounds and generally worked at high levels of hierarchy and responsibility in different institutions. They had long-standing experience working in various sectors of the Ghana national health system, particularly on NCDs and other related subjects. All participants were involved in drafting and developing the 2012 National Policy for the Prevention and Control of Chronic Non-Communicable Diseases in Ghana. As such, all participants had been involved in defining the technical direction and framework for implementing NCD-related programmes in the country [49].

**Selection criteria**
A list of the members of the technical working group for Ghana’s national NCD policy was retrieved from the document titled ‘Strategy for the Management, Prevention and Control of Non-Communicable Diseases in Ghana’ by the Republic of Ghana Ministry of Health [49]. The list consisted of a total number of 19 members who were contacted by DO and who received information about the study via Emails, Telephone and Skype calls. Participation was voluntary and participants were assured that information such as names and addresses that could lead to their identification would be avoided to ensure privacy. Those who responded were followed up for the interviews. No restrictions were imposed except that participation was based on availability and willingness to contribute during the period of data collection.

**Analysis**
Following the QCA approach [47, 50], the coding frame in Figure 1 was used for the analysis. It was largely based on the mHealth PNE framework. The framework theorizes that successful implementation of mHealth interventions is determined by context factors – *predisposing characteristics, enabling factors and need* – of patients and healthcare providers, which influence their perceptions on the usefulness and ease of use of the intervention [20]. Thus, for example, whether a mobile phone-based self-monitoring blood glucose intervention designed for diabetes care in Ghana will be successful or not depends on whether both diabetic patients and their healthcare providers perceive the intervention to be useful and easy to use.

According to the framework the perceived usefulness and ease of use of an intervention are determined by: (1) patients’ predisposing characteristics, such as the age, attitude, literacy, language, cultural/social acceptability; (2) their needs, such as reducing financial burden of care and avoiding long travel/waiting time; and (3) the factors that will enable them to utilize the intervention well, which may include access to a mobile phone and a stable network [20]. Also
perceived usefulness and ease of use of providers depend on predisposing characteristics (e.g. technology-related training), needs (e.g. human resource capacity), and enabling resources (e.g. tolerable workload and incentives) [20].

**Figure 1.** Coding frame for analysis based on the mHealth PNE framework.

![Coding frame for analysis based on the mHealth PNE framework](image)

*Source: authors' own configuration based on Opoku et al.2017 [20]*

The interview transcripts for the analysis were coded according to the various components of the framework and grouped into main categories and sub-categories. The two main categories were: **Knowledge of and attitudes towards mHealth** and **Context factors determining sustainability of mHealth** (Patient Context Factors and Provider Context Factors). The results were analysed mainly based on the three sub-categories of the framework (i.e. predisposing characteristics, need and enabling resources) and then presented thematically under each of the main categories. The analysis also sought to identify other potentially relevant factors missing in the current framework.

**Results**

**Characteristics of participants**

Out of the 19 policy-makers who were contacted, 13 participated in the study. The participant policy-makers had long standing experiences of an average of 26 years in managing various health programmes, interventions and departments and were actively involved in health policy-
making processes in Ghana. With the exception of four participants who had retired at the time the interviews were conducted, all were serving in high-level (national) capacities at the Ministry of Health, Ghana Health Services, academia, the public and private sectors. Table 1 summarizes the characteristics of the participants.

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age (years)</th>
<th>Profession</th>
<th>Working experience with NCDs</th>
<th>Years of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Male</td>
<td>50+</td>
<td>Medical Doctor, Epidemiologist</td>
<td>medical practice, programme management, policy</td>
<td>21</td>
</tr>
<tr>
<td>R2</td>
<td>Male</td>
<td>50+</td>
<td>General Practitioner, Public Health Consultant</td>
<td>medical practice, programme management, policy</td>
<td>36</td>
</tr>
<tr>
<td>R3</td>
<td>Male</td>
<td>50+ (retired)</td>
<td>Medical Doctor, Political Scientist, Epidemiologist, Lecturer</td>
<td>medical practice, teaching, research, programme management, policy</td>
<td>41</td>
</tr>
<tr>
<td>R4</td>
<td>Male</td>
<td>50+</td>
<td>Pharmacist, Public Health Researcher</td>
<td>research, health information management, policy</td>
<td>33</td>
</tr>
<tr>
<td>R5</td>
<td>Male</td>
<td>50+</td>
<td>Health Educator, Programme Manager</td>
<td>health education, training, research, communication, programme management, policy</td>
<td>25</td>
</tr>
<tr>
<td>R6</td>
<td>Male</td>
<td>40 – 44</td>
<td>Disease Surveillance Officer, International Health Specialist, Programme Coordinator</td>
<td>health regulations, disease control and prevention, policy</td>
<td>19</td>
</tr>
<tr>
<td>R7</td>
<td>Male</td>
<td>40 – 44</td>
<td>Public Health Pharmacist, Programme Manager</td>
<td>medical practice, disease control and prevention, policy</td>
<td>13</td>
</tr>
<tr>
<td>R8</td>
<td>Female</td>
<td>45 – 49</td>
<td>Dietician, Public Health Practitioner</td>
<td>clinical practice, health promotion, policy</td>
<td>20</td>
</tr>
<tr>
<td>R9</td>
<td>Male</td>
<td>45 – 49</td>
<td>Public Health Lecturer, Researcher, Policy Advisor</td>
<td>teaching, research, consultancy</td>
<td>16</td>
</tr>
<tr>
<td>R10</td>
<td>Female</td>
<td>50+</td>
<td>Health Educationist</td>
<td>health promotion, disease</td>
<td>&gt; 30</td>
</tr>
</tbody>
</table>
Table: Participants’ characteristics

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Age</th>
<th>Profession</th>
<th>Experience</th>
<th>Experience Details</th>
<th>Experience Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11</td>
<td>Male</td>
<td>50+</td>
<td>Planning Officer, Policy Analyst, Teacher</td>
<td>30</td>
<td>Health sector coordination, programme management, policy</td>
<td>30</td>
</tr>
<tr>
<td>R12</td>
<td>Male</td>
<td>50+</td>
<td>Public Health Lecturer, Researcher, Policy Advisor</td>
<td>21</td>
<td>Teaching, research, consultancy</td>
<td>21</td>
</tr>
<tr>
<td>R13</td>
<td>Female</td>
<td>50+</td>
<td>Freelance Nutritionist</td>
<td>34</td>
<td>Health promotion, advocacy, policy</td>
<td>34</td>
</tr>
</tbody>
</table>

Source: authors’ own compilation

Knowledge of and attitude towards mHealth interventions

Interviewed policy-makers had considerable knowledge of mHealth interventions, broadly in relation to the general field of health (prevention and health promotion, healthcare delivery – maternal and child healthcare) and some specifically relating to NCDs (hypertension prevention and control). Some of the policy-makers actually had long time experience with mHealth and had been involved in the use of mobile phones to support healthcare delivery, either as providers or as patients themselves.

All interviewees agreed that mHealth interventions can contribute to improved NCD management in Ghana. They identified a range of potentially beneficial applications: awareness creation and (regenerative) health education, early detection of NCD conditions, reduction of waiting time, follow-ups and monitoring, keeping track of the appointments of patients, vital statistics and adherence to medication, emergency alert, creating registries, record keeping, dissemination of evidence, and ensuring sustainable healthcare. Most importantly, the policy-makers highlighted that mHealth could potentially help patients to better manage their NCDs and improve treatment compliance:

“… [it] can keep patients in care, reduce morbidity, reduce mortality. Definitely because it’s all a matter of keeping them [patients] in care and ensuring that they learn the good practices and all that. So I think it would help the outcomes, we will get better outcomes, reduce the disabilities from NCDs and also reduce the mortalities from NCDs, definitely!” [R:1]
“For me the biggest impact is that it will help to manage treatments, it will reduce treatment failures and it will help people to be more productive so that people can then take better care of themselves and not spend all the time going to the hospitals.” [R:4]

At the same time, interviewees noted that mHealth interventions provide a solution for only some of the problems of NCD management in Ghana.

“I always get worried when people try to use technology as a ‘fix all’. Technology is not a fix all, it fixes some problems but not all problems and it’s contextual.” [R:1]

Given the complexity of NCD management, mHealth consultations were considered to be safe and suitable mostly for follow-ups, after an initial contact between patients and providers has been established:

“…there are huge potentials when it comes to the use of mobile phones but for non-communicable diseases, the evidence is not very clear for us...from our experience it has to be a ‘post-contact’ intervention. There is always the first contact that has to be made [at the facility] and then the intervention kicks in as a follow-up; only after the initial contact. If you don’t have initial contact with the hospital, the opportunity to rope in ICT to help you to readjust and to be healthier becomes a bit of a problem.” [R:4]

However, the policy-makers maintained that the use of mobile phones in health is becoming an important strategy in Ghana, particularly in reducing maternal mortalities and controlling epidemics. In fact, the policy-makers were enthusiastic about the potential of mHealth to improve NCD management in Ghana:

“It is a very good idea, brilliant idea! I mean it is something that we've always been talking about that people should be able to stay in their houses and manage or even call doctors to come or even call for advice from doctors” [R:5]

**Perspectives of policy-makers on context factors determining sustainability of mHealth in Ghana**

This section presents the interview results categorized along the three context factors of the analytical framework, i.e. predisposing characteristics, need and enabling resources. Table 2 provides a summary of the identified factors supporting and/or expanding the framework.

**Table 2.** Summary of the identified factors supporting the mHealth PNE framework
<table>
<thead>
<tr>
<th><strong>Mechanism</strong></th>
<th><strong>Context</strong></th>
<th><strong>Patient</strong></th>
<th><strong>(First-contact/Specialized) Provider</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predisposing Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● social class (middle) [R:1]</td>
<td>● perceived usefulness</td>
<td>● (positive) attitude interest, dedication, willingness and motivation [R:1,8,12]</td>
<td></td>
</tr>
<tr>
<td>● myths, fear/phobia, misconceptions [R:2,5,6,10]</td>
<td>● perceived ease of use</td>
<td>● language [R:5,9]</td>
<td></td>
</tr>
<tr>
<td>● locality (urban/rural) [R:2,8]</td>
<td>● continuity of care [R:1,13]</td>
<td>● good (provider: patient/community) relationship [R:4,8,11]</td>
<td></td>
</tr>
<tr>
<td>● informed, convinced, trust and confident (satisfaction) [R:2,8,11]</td>
<td>● technology-driven need/demand [R:2,3,4,6,13]</td>
<td>● trust and confidence [R:11]</td>
<td></td>
</tr>
<tr>
<td>● (self-)motivation [R:3]</td>
<td></td>
<td>● ready to support [R:13]</td>
<td></td>
</tr>
<tr>
<td>● socio-culture [R:4,7]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● acceptance [R:5,6]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● (positive) attitude [R:5,12]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● (local) language [R:5,6,11,12]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● age [R:8]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● gender [R:8]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Need</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● disease condition (severity, upsurge, uncertainties of care) [R:1,2,4,6,9,13]</td>
<td>● penetration and familiarity (urban) [R:1,5,6,13]</td>
<td>● Continuous training, upgrade and education [R:4,7,9,10,11,12]</td>
<td></td>
</tr>
<tr>
<td>● healthcare access barriers (poverty, transportation, ineffective health facilities, distance, travel and waiting time, cost, urgency and quality of care, stress reduction and satisfaction) [R:2,3,4,9,10,12,13]</td>
<td>● literacy and level of education [R:1,2,3,4,5,6,7,11,12]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● need for urgent/special care [R:7,8,9,13]</td>
<td>● age (youth ≥10yrs, adults) [R:2,3,5,7,10,13]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>● training, know-how, confidence [R:3,4,5,12]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>● basic, simple [R:6,8]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>● personalization [R:8,11]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Enabling resources

- availability and affordability of (telecommunication) services [R:1,3,5,6,11,12,13]
- access to mobile phone [R:1,4,6,7,8,11,12,13]
- functioning infrastructure (mobile network/connectivity, transport system, electricity, basic test equipment) [R:1,4,6,7,8,9,11,12,13]
- partnership and support [R:2,3,7,9]
- awareness creation [R:2,5]
- avoidance of abuse [R:4,12]
- convenience [R:6]
- confidentiality and privacy [R:8]
- (community) support [R:10]
- (family) support [R:8]
- Portability and easy-to-use [R:6,13]
- maintenance (battery recharge) [R:12]
- phone access [R:1,4,10]
- quality, availability and affordability of services [R:1,7,10,12]
- (mHealth) guidelines [R:1]
- legislation and policy (phone usage, liability, funding mechanisms and reimbursement, data security and privacy, staff job description, partners) [R:1,2,4,5,6,7,8,9,13]
- infrastructure (functioning network services, equipment) [R:1,5,6,8,10,11]
- (government, institutional, sectoral, stakeholders') support [R:1,4,5,7,9,10,12,13]
- financial resources and incentives [R:1,6,9,10,11,12]
- documentation and record-keeping [R:1,2,9]
- cost-effectiveness [R:5,8,10]
- evidence-informed (research, expert advice) [R:5,10,11]
- sustainability plan [R:7,10,12,13]
- awareness [R:10]
- abuse/corruption [R:11]
- type of (available) technologies [R:1]
- simple, safest and easy technologies/intervention (Apps, softwares, etc.) [R:1,4]
- maintenance [R:6]
- phone features (screen, tailored operability) [R:7]

NB: Grey highlights are the additional patient and provider context factors of the mHealth PNE framework identified in this study

Source: authors' own compilation based on interview results

Predisposing characteristics

According to the framework, the most important predisposing characteristics supporting the implementation of mHealth interventions are a positive attitude, cultural/social acceptance and a common language of communication. The interviewed policy-makers also highlighted the importance of a positive attitude towards mHealth interventions:
“...and when people are convinced, they will use it and if they are satisfied, they can also pass it onto their very good friends. Now they will accept it from their friends rather than from the medical practitioner and so if we have a few satisfied clients, they can pass on the message to other people.” [R:2]

However, they also stressed that, more generally, trust and confidence between healthcare providers is a prerequisite for successful implementation of mHealth:

“The other thing would have to do with the [health] staff attitude. The major question is that, for example, if I [a specialised healthcare provider] at Korle-Bu teaching hospital [in Accra] give instructions to those [healthcare providers] in the rural areas, how sure am I that they are doing what I am instructing them to do? And if anything at all should go wrong, who is to be blamed; me or those out there? So amongst the health staff, there are usually pessimistic views and so some of them will not be interested in these innovations but others might.” [R:9]

In addition, interviewees highlighted that attitudes of patients related to myths, misconceptions, fear of change and phobia for technological innovations may negatively impact on patients' perceptions about the usefulness of mHealth interventions:

“We need to look at people’s phobia for technology and see how that barrier can be broken.” [R:6]

“Maybe we still maintain the old ways of doing things; we don’t like change. Africans in general but Ghanaians especially, we fear change. It is a fact that we fear about what if it doesn’t work out well and who takes the fall for it!” [R:10]

With regard to predisposing characteristics influencing the perceived ease-of-use, interviewees believed that urban populations are more familiar with mobile technologies. However, in general, the Ghanaian population was thought to be ready to use mobile phones for healthcare given the high penetration of the technology.

**Need**

The framework stipulates that patient and provider needs, such as access barriers for patients (e.g. long travel times and costs) and providers’ lack of capacity to provide adequate care, influence the utilization of mHealth interventions in SSA. In this study, interviewed policy-makers suggested that patients who face healthcare access barriers of various forms and nature are more likely to perceive mHealth interventions as useful (see Table 2). They considered patients
in need of special/urgent care to benefit most from mHealth interventions, particularly if interventions contribute to reduced travel times and better access to providers:

“It would be useful; it would reduce a whole lot of travelling time and reduce some stress levels in getting vehicle/transport. It may even cut down on mortality because it can enhance emergency treatment and emergency care.” [R:11]

“It would be very much useful in our settings and circumstances where many people do not even have access to the health facilities because of absence of the health facility, low numbers of health workers; that is, the low patient to health worker ratio. If health professionals can be reached via mobile phones or other ICTs, that would improve the chances of more people getting access and it would even lead to realizing the universal health coverage.” [R:12]

Furthermore, interviewees mentioned several tasks for which mHealth interventions would respond to the needs of healthcare providers, thus contributing to perceived usefulness and ease of use of mHealth interventions. For example, to use mobile phones for regular monitoring of blood sugar levels of diabetic patients:

“We are aware that the health system in Ghana is stricken by lack of facilities and diagnostics, and the health staffs are not motivated to go and stay in the rural areas... and because we won’t have enough doctors and enough experts in the rural areas then we can’t run away from telemedicine.” [R:9]

“...if we are talking specifically about testing fasting blood sugar, it shouldn’t be that the patients wait at the clinic...because we all know that the patients have to fast and for a diabetic, once you haven’t taken the blood sample s/he cannot eat. There should be enough healthcare providers available at all times to attend to them immediately. And so that should be organized well, a mobile phone can help do that easily...” [R:3]

Notably, the framework did not specify which particular needs of patients influence their perceived ease of use of mHealth interventions. Nonetheless, the interviewed policy-makers suggested that the general trend to use information technology for other services may create a need to use mHealth in the management of NCDs, while simultaneously making it easier to use the technology:
“We are in a technology age; whether we like it or not, technology is taking over and the earlier we get ourselves involved the better because there would be a time where all banking would be done online. So the fact that one is not computer literate nor mobile phone literate it cannot be assumed that the world should wait for us. So it has to be done and it is being done.” [R:3]

Enabling resources
Enabling resources were the most emphasized considerations of the interviewees in determining the sustainability of mHealth. The framework suggested that the two most important enabling resources for the successful implementation of mHealth interventions are access to mobile phones (or devices) and the availability of functioning stable telecommunication networks. Accordingly, the interviewees maintained that mHealth interventions could be perceived as useful by both patients and healthcare providers only if access to mobile phones, availability and affordability of the infrastructure for good quality (telecommunication) services, and the avoidance of system abuse are assured (see Table 2):

“Now we are having a lot of mobile phone services but we do have challenges with them. We need to have stable mobile phone services that are good. The services must be available everywhere.” [R:3]

In addition, policy-makers suggested that legislation, policies and guidelines are needed to guide the activities of (healthcare) providers. However, they maintained that such policies for the explicit purposes of mHealth interventions should be appropriately informed by the evidence from, for example, pilot projects that first need to be conducted. Furthermore, they highlighted that availability of financial resources would be an important enabling resource but that financial support and commitment from governments for mHealth interventions still remains low due to resource constraints:

“[…] Yea, will you buy vaccines or you buy phones. I will rather buy vaccines than buy phones. Those are the realities that we deal with as people at the policy level. […] So those are the trade-offs that we make at the national level and it’s not an easy trade-offs […] Also we need to really come out clearly what the parameters should be. We developed a mobile device guideline and we did advocate that the mobile phone is a medical device and so the health facilities have to provide them.” [R:1]
“I believe in doing pilot projects before developing the policies because the findings of the pilot project should guide the policy. So the immediate thing is to have a project with the NCD programme… it can be part of the priorities of the Ministry of Health. [R:5]

Interviewees identified several conditions that would enable patients to easily use mHealth interventions, including, for example, family support and availability of maintenance services. In the same vain, they emphasized that attention should be given to the suitability of the technologies for healthcare providers including certain specific features, such as the size of the screen:

“…one mobile phone platform they created for health professionals to monitor those [patients] who are on medications, they secured an Android phone for all of them, I mean something with a bigger screen that they could do so many things on it. I think it has been tailored.” [R:7]

Discussion
To our knowledge, this is the first study that has investigated the views of policy-makers about factors that support successful implementation and scale-up of mHealth interventions. We found that policy-makers in Ghana were well informed about the potential of using mobile phones for health promotion, prevention, and health service delivery – and they strongly supported the further expansion of mHealth in the country. The results of the study also showed that the mHealth PNE framework's categories of predisposing characteristics, need and enabling resources are useful for structuring the thinking of policy-makers about factors that support the implementation of mHealth interventions. Furthermore, the responses of interviewed policy-makers showed that they are thinking of many of the factors suggested by the mHealth PNE framework but that they tend to focus more on enabling resources than on predisposing characteristics and needs. Finally, policy-makers added several relevant factors under the categories of the mHealth PNE framework that should be considered when aiming to assure sustainability and scale-up of mHealth interventions.

These findings have several important implications for policy-makers and researchers as well as for the further refinement of the mHealth PNE framework. Firstly, this study shows that policy-makers are aware of many of the factors that have been described in the literature as particularly important for assuring successful implementation and scale-up of mHealth
interventions for NCDs. For example, in line with previous literature [20], the participating policy-makers highlighted that a positive attitude of both patients and providers towards mobile technologies is one of the most important factors influencing the perception of patients and providers that mHealth interventions are useful and easy to use. Similarly, their assessment that patients in need of special/urgent care are likely to benefit most from mHealth is in accordance with previous findings in the literature. This implies that policy-makers in Ghana broadly agree with the findings of our systematic review [20] that it is important to consider context factors, i.e. predisposing characteristics, need, and enabling resources, when developing and implementing mHealth interventions for NCDs. In fact, these context factors can be more important than the technical aspects of an intervention in determining its success [20, 51–53].

Secondly, because the thinking of policy-makers tends to focus on enabling resources, such as functioning telecommunication infrastructure, sustainable financing and support from stakeholders, the mHealth PNE framework can be useful to facilitate a more holistic and systematic assessment of other factors supporting successful implementation, sustainability and scale-up of mHealth interventions for NCDs. The mHealth PNE framework (see Table 2) provides a long list of predisposing characteristics of patients and providers as well as of their needs, which can be used as a guide by policy-makers during implementation, sustainability and scale-up.

Thirdly, this study has contributed to the refinement of the mHealth PNE framework by identifying additional patient and provider context factors that should be considered during implementation, sustainability and scale-up of mHealth interventions. This includes patients' predisposing characteristics, such as gender, urban/rural location, and personalisation of technologies; patients' need, such as their need for urgent/specialized care; and patients' enabling resources, such as avoidance of abuse, partnership and (family) support. Concerning providers, policy-makers identified additional predisposing characteristics, such as good (provider-to-patient/community) relationships; additional need factors, such as the need for exchange of expertise, and for continuity of care; and additional enabling resources, such as support from government, and other stakeholders (see Table 2). Interestingly, policy-makers noted that the increasing utilization of mobile phones by patients for services of other sectors, for example, in the financial/banking sector [54, 55], may create a desire (or “need”) to also have mobile phone based services in the health sector, which, in turn, may contribute to patients finding these technologies easy to use.
Finally, while the study shows that the categories of the framework are useful for policy-makers, further (quantitative) research is required to test the validity of the framework and to explore the relative importance of the identified context factors for successful implementation, sustainability and scale-up of mHealth interventions for NCDs. This may include, for example, studies testing the relevance of the identified context factors during the implementation of the World Health Organization’s Package for Essential NCD (WHO-PEN) interventions (i.e. integration of NCDs into primary health care) [9, 56] using mobile technologies.

Limitations
This study has several limitations. Recruitment of participants relied on the list of members of the technical working group for Ghana’s national NCD policy. This does not constitute a representative sampling of all relevant policy-makers, and it has a bias towards the inclusion of policy-makers with expertise in the area of NCDs, while possibly missing policy-makers with expertise in the area of mHealth. However, selected policy-makers demonstrated that they had considerable knowledge in the area of mHealth, besides their long-standing experience from working in the health sector in Ghana.

The scope of this study was also limited by the use of qualitative methods. As a result, the contextual factors summarized in Table 2 are rather indicative. It is very likely that there are further predisposing characteristics, enabling resources, and needs that are relevant for the implementation and scale-up of mHealth interventions for NCDs beyond those identified by the interviewed policy-makers or by our systematic review [20]. In addition, the relative importance of the identified factors remains unknown. Therefore, more research is needed to confirm the mHealth PNE framework and to operationalize some of its categories. For example, concerning the interplay of predisposing characteristics and perceived usefulness (see Table 2), quantitative research is needed to confirm that a positive attitude towards mHealth is a predictor of perceived usefulness. This requires an operationalization for measuring a positive attitude and for quantifying its impact on the sustained use of mHealth for NCDs. Ideally, the mHealth PNE framework would be tested using a large dataset from a multi-country mHealth trial, allowing sufficient variation in the context factors that are hypothesized to influence long-term success of interventions.
Conclusions
There is great potential for mHealth interventions to improve treatment and care for patients with NCDs in SSA. Yet, the views of policy-makers about factors that support the successful implementation, sustainability and scale-up of these interventions used to be unexplored. Our qualitative study found that policy-makers in Ghana are aware of many of the factors that have been described in the literature as particularly important for assuring successful implementation, sustainability and scale-up of mHealth interventions for NCDs. In addition, the study showed that the mHealth PNE framework is useful to guide policy-makers towards a more holistic and systematic assessment of context factors that support intervention implementation, sustainability and scale-up, such as predisposing characteristics of patients and providers as well as their needs. Furthermore, the study allowed to refine the mHealth PNE framework by identifying additional context factors under the categories of predisposing characteristics, need, and enabling resources that support implementation, sustainability and scale-up of mHealth interventions for NCDs.

The implication of these findings is that policy-makers may benefit from using the mHealth PNE framework at the various stages of implementation and scale-up of mHealth interventions for NCDs. However, it is important to be aware that the framework is still in its early stages of development. Researchers may (and should) use the framework when investigating reasons for success (or failure) of interventions. Over the years, such an emerging body of evidence will contribute to confirming and/or refining the factors proposed by the mHealth PNE framework, and it may ultimately allow quantifying the relative importance of these factors.

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Conflict of Interest
None declared
References


