Stephani, Victor

Book

Effective and needed, but not used : why do mobile phone-based health interventions in Africa not move beyond the project status?

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Victor Stephani

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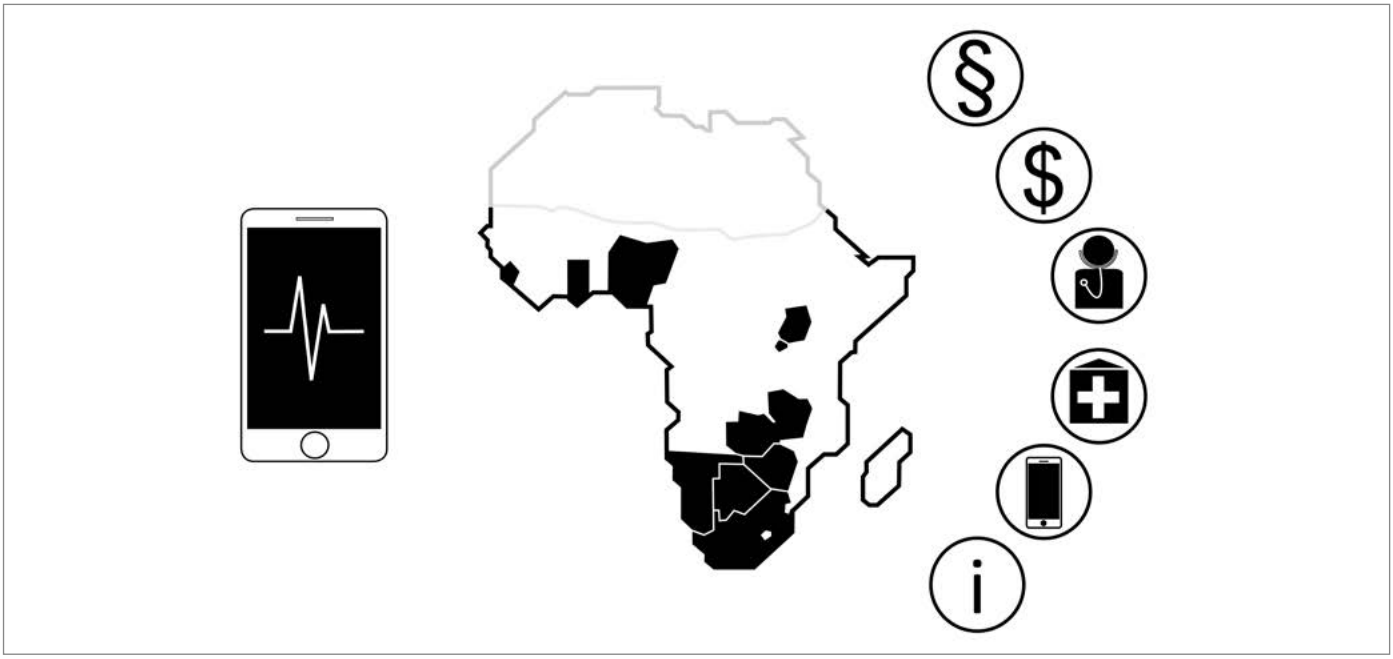

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Abstract

Introduction: Reviews have shown that mobile phone-based health interventions (mHealth interventions) are capable of improving health outcomes of patients in Africa. Particularly patients with chronic diseases such as non-communicable diseases (NCDs) benefit from mHealth interventions. But the current African mHealth landscape suffers from the problem of the so called pilotitis: Most projects are stopped after the pilot and the funding of the donors has ceased and do not become part of the health systems. Therefore, the aim is to assess the process of implementation and to identify the reasons for the lacking integration of mHealth interventions against NCDs in sub Saharan African health systems.

Method: 10 countries from Sub-Saharan Africa (SSA) were selected for the analysis. For the assessment a catalogue of indicators was developed. The catalogue and its indicators were derived from the 'health system building blocks framework' by the World Health Organization. Data for the indicators was gathered from various sources: databases, literature reviews and expert interviews.

Results: Inhibiting factors for the further uptake of mHealth are the lack of specific action points by the governments, the missing attention paid to the rising burden of NCDs, the non-utilization of the full potential of mHealth, the lack of financial incentives and standardized workshops/guidelines and lack of good governance. The access to mobile phones is also inhibited by the poor electricity infrastructure.

Enabling factors in many countries are numerous published eHealth strategies, constantly improving legislative frameworks (such as data protection laws) and a growing technology start-up ecosystem.

Conclusion: mHealth against NCDs is still in its infancy. The SSA mHealth landscape lacks steering and monitoring. The rapidly growing technology start-up environment in some countries could lower the problem of donor-dependencies and lacking sustainability.

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Abbreviations

CCC	COMESA Competition Commission
CIA	Central Intelligence Agency
CMHI	Center for Health Market Innovation
COMESA	Common Market for Eastern and Southern Africa
CR Score	Consumer Readiness Score
EU	European Union
GDPR	General Data Protection Rule
GSMA	Global System for Mobile Communications Association
HDI	Human Development Index
HHD	High Human Development
ITU	International Technology Union
IXP	Internet Exchange Points
LHD	Low Human Development
LTE	Long Term Evolution
MHD	Medium Human Development
mHealth	Mobile Health
NCD	Non Communicable Diseases
NMRA	National Medicines Regulatory Agency
SDGs	Sustainable Development Goals
SELFIE	Sustainable intEgrated chronic care modeLs for multi-morbidity: delivery, FinancIng and pErformance
SSA	Sub-Saharan Africa
USA	United States of America
USAID	U.S. Agency for International Development
WHO	World Health Organization
WTO	World Trade Organization

1 Introduction

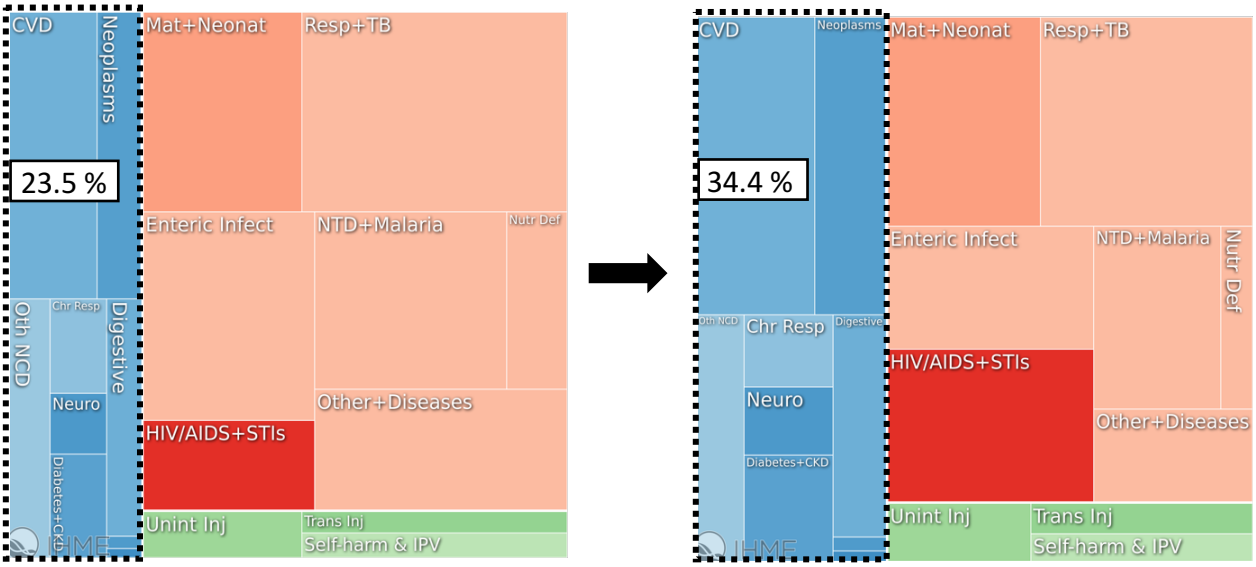
Health care systems in Africa face many challenges.

This applies particularly to the poorest region of the continent: Sub-Saharan Africa (SSA). First, health facilities are sparsely distributed, limited in their access to clean water and electricity and often poorly equipped. This is primarily caused by a lack of money: health expenditure in 2015 was only 84 Dollar per capita – much lower than spending in other regions of the world (e. g. the European Union (EU) spends 3,183 Dollar and the United States of America (USA) 9,535 Dollar per capita) [1]. Second, there is an extreme shortage of health-workers. In 2015, the SSA Region had an average of 1.30 health workers per 1,000 citizens – far below the 4.45 per 1,000 required for reaching the United Nations Sustainable Development Goals (SDGs) [2, 3]. And third, there is a serious lack of *good governance*, which increases the challenges through an inadequate legislation enforcement, corruption in the procurement system and an inefficient resource allocation [4–6].

At the same time, there is a slowly growing middle class in SSA that brings socioeconomic and demographic changes: The life-expectancy increases, people migrate from rural to urban areas and they change their lifestyle (e. g. nutrition or physical activities) [7, 8].

This leads to a shift in the burden of disease. People get less infectious diseases and are more likely to get so-called *diseases of wealth*, also referred to as Non-Communicable Diseases (NCDs) [9].

Figure 1: Causes of deaths in SSA in 2000 and 2017 with % of death caused by NCDs (dotted boxes), figure adapted from [10]



In 2017 more than one third of deaths were already caused by diseases such as cancer, cardiovascular diseases or diabetes (figure 1) [10]. And it is expected that this trend will continue and NCDs will be the main cause of death in 2030 [11].
The shift from communicable diseases to NCDs has far reaching implications for the health-systems [12]. NCDs are mostly chronic diseases. They are defined by their long duration and their slow progression. In contrast to acute diseases, they necessitate long term management and provision of mostly life-long integrated care [13]. But current health systems in SSA are primarily built around acute events and are not yet prepared and aligned to manage and care for NCDs [12]. As a consequence, people with NCDs receive an even more inadequate care than those with communicable diseases. And they are also poorly educated in how to self-manage their disease [14].

Despite all these challenges, there are glimpses of hope.
In the last years an almost invisible infrastructure has spread over the continent: the mobile phone infrastructure. Mobile phones have become one of the dominating ways of communication. In SSA, it is estimated that there are almost 500 million people having access to mobile phones, equivalent to a 'unique mobile subscriber' rate of 43 % [15]. As a result, people in many African countries have better access to mobile phones than to paved roads or sanitary facilities [16].
Through the access to technology and the easier exchange of information, mobile phones have started to change many areas of people's daily live [17, 18].
Particularly in the area of health, mobile phones have been used in many ways, such as for the provision of information (e. g. informing patients about a certain disease/condition). This mobile phone supported delivery of health care and management is also referred to as 'mobile health' (mHealth) [19]. Several systematic reviews have shown that mHealth is capable of improving patients' health outcomes, particularly for patients with chronic NCDs [20–22].

The potential of mHealth has been widely recognized and therefore many mHealth pilot projects have been implemented in SSA in recent years. But despite the enthusiasm, the African mHealth-landscape suffers from the problem of the so called *pilotitis*: most projects are stopped after the pilot and the funding of the donors has ceased [23]. mHealth interventions usually don't make the leap into standard care of the healthcare systems. Most mHealth projects, which have proven their efficacy, *vanish in beauty*.

This raises the question of ‘Why?’.

Why do mHealth interventions not move beyond the project status – although their efficacy has been proven and although the need is very high?

The aim is to identify the reasons for the lacking implementation of mHealth in sub Saharan African health systems. Therefore, the current level of the system implementation of mHealth in Sub-Saharan Africa is analyzed. The focus of the analysis is on mHealth interventions against NCDs.

2 Method

2.1 Selection of Countries

For the analysis of Sub-Saharan Africa, 10 sample countries were selected. The selection was discussed with Verena Struckmann (VeS)[1]. Final decisions on inclusions were made jointly among Victor Stephani (ViS) and VeS.
Included were countries that use English as their official language. In addition, emphasis has been placed on a balanced mix of countries at different stages of development. Therefore, the Human Development Index (HDI) classification system was used and countries with a low, medium and high human development (LHD, MHD, HHD) were included [24].
Based on these criteria, the following countries were finally chosen for the analysis: Botswana (HHD), Ghana, Namibia, South Africa, Zambia (all MHD) and Nigeria, Rwanda, Sierra Leone, Uganda, Zimbabwe (all LHD).

2.2 Framework and Indicator Selection

For the analysis of the health systems, a catalogue of indicators was developed.
The catalogue and its indicators were derived from two frameworks: the 'health system building blocks framework' by the World Health Organization (WHO) and the SELFIE framework.

2.2.1 The Health System Building Blocks Framework

The health system building blocks framework (also referred to as 'WHO Building Blocks') was proposed by the WHO in 2007 [25]. The framework consists of all organizations, people and actions whose primary intent is to promote, restore and maintain health. It organizes health systems into six functions (also called building blocks):

- Leadership & Governance
- Information & Re search
- Workforce
- Financing
- Service Delivery
- Technologies & Medical Products

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The blocks of *Leadership & Governance* and *Information & Research* provide the basis for the overall policy and regulation of the health system. Inputs to the health systems are given by the blocks *Financing* and *Workforce*. And the outputs, e. g. the availability of care, are reflected by *Service Delivery* and *Technologies & Medical Products* [26].

2.2.2 The SELFIE Framework

For the analysis, the WHO Building Blocks were combined with a framework developed as part of the SELFIE project ('Sustainable intEgrated chronic care modeLs for multi-morbidity: delivery, FinancIng, and pErformance'), an EU-funded project (PHC-23-2014) [27]. The project aims at the provision of policy advices on integrated care for persons with multi-morbidity. As part of the project, a framework was developed which captures relevant elements which need to be considered when reviewing integrated care models for patients with multi-morbidity. The elements are categorized according to the WHO Building Blocks. Furthermore, the elements are divided into a micro-, meso- and macro-level. While the micro level adopts a patient perspective, the macro-level considers institutional and the macro-level the system aspects.

2.2.3 Indicator Selection

Since a system view was carried out, only indicators from the macro perspective of the SELFIE framework were considered. Based on macro-level indicators in combination with the WHO Building Blocks descriptions, final indicators for the analysis were derived.
The selection of the indicators was discussed with VeS. The catalogue of all final indicators in combination with the underlying explanation of the WHO Building Blocks and the explanation of the macro perspective of the SELFIE framework is provided in table 1.

2.3 Data sources

Data for the selected indicators was gathered from various sources: (1) Databases provided by international organizations were used and (2) mHealth databases were systematically searched. In addition, (3) peer-reviewed literature and grey literature was used, and mHealth experts from the respective countries were contacted and interviewed. The indicators and their associated primary sources are listed in table 2.

Table 1: Indicator selection based on the WHO Building Blocks and the macro-level perspective of the SELFIE framework

WHO Building Blocks	SELFIE-Macro Level	Selected Indicators
SERVICE DELIVERY: The service delivery depends on e. g. close-to-client care and the provision of required clinical and public health interventions that respond to the full range of health problems	Service availability & access	Access to cellular infrastructure
		Disease-focus of mHealth interventions
	Market regulation	Collaboration between providers while ensuring consumers choice
LEADERSHIP & GOVERNANCE: The authorities steer the health sector and deal with future challenges. They define health policies, strategies and plans with a clear direction	Policy & action plans, political commitment	eHealth strategy
		mHealth strategy
		Focus on non-communicable diseases in the strategies
WORKFORCE: The health workforce is responsive to needs and expectations. Furthermore, the workforce is fair, efficient and achieves the best outcomes possible	Education & workforce planning	Incentives for using mHealth
		Workshops/Guidelines
	Workforce-demography match	Mobile phone literacy
FINANCING: This is a key instrument to reduce health inequalities and to remove financial barriers by e. g. raising funds for health fairly among the population and pooling financial resources across population groups	Stimulating investments in innovative care models	Governments involvement in mHealth interventions
	Financial system for health & social care	Affordability of mHealth interventions
	Equity access	Affordability of mobile services
TECHNOLOGIES & MEDICAL PRODUCTS: This considers the situation regarding technologies and medical products, which includes e. g. the existence of a regulatory system for medical products and ensures access to technologies.	Policies fostering technological innovation	Innovation friendliness
	Access to technologies & medical products	Regulatory system for medical devices
		Access to electricity
INFORMATION & RESEARCH: Good information on health challenges and the environment, e. g. on the progress of meeting health challenges and social objectives of the consumption of and access to technologies	Privacy & data legislation	Legislative framework for protection of data
	Policies that stimulate research	mHealth related research activities
		Access to information

2.3.1 International Databases

Data on the 'cellular infrastructure', the 'affordability of mobile services' as well as the 'mobile phone literacy' was obtained from the 'Mobile Connectivity Index 2018 – Global Scores' (data from 2017). The data is regularly published by the 'Global System for Mobile Communications Association' (GSMA), which is the umbrella organization for mobile network operators. Data on the 'access to electricity' was taken from 'World Fact Book' database, provided by the Central Intelligence Agency (CIA) (data from 2016).

Table 2: Data sources for selected indicators

Building Block	Indicator	Primary Data Source
Service Delivery	Access to cellular infrastructure	'Infrastructure Index' by GSMA
	Disease-focus of mHealth interventions	mHealth databases
	Collaboration between providers while ensuring consumers choice	Literature / Experts
Leadership & Governance	eHealth strategy	Literature / Experts
	mHealth strategy	Literature / Experts
	Focus on NCDs in the strategies	Literature / Experts
Workforce	Incentives for using mHealth	Literature / Experts
	Workshops/Guidelines	Literature / Experts
	Mobile phone literacy	'Consumer Readiness' Index by GSMA
Financing	Governments involvement in mHealth interventions	mHealth databases
	Affordability of mHealth interventions	mHealth databases
	Affordability of mobile services	'Affordability Index' by GSMA
Technologies	Innovation friendliness	'Ease of Doing Business Report' by Worldbank
	Regulatory system for medical devices	'Global atlas of medical devices' by WHO
	Access to electricity	'Access-to-electricity Index' by World Fact Book
Information & Research	Legislative framework for protection of data	Literature / Experts
	mHealth related research activities	MEDLINE Database
	Access to information	Literature / Experts

For assessing the 'innovation friendliness' of the countries, the 'Ease of Doing Business' Report, published by the Worldbank was used (data from 2017). The presence of an agency responsible for implementing and enforcing regulations on medical devices was retrieved from the WHOs 'Global Atlas of Medical Devices' (data from 2015 and 2016).

2.4 mHealth databases

Information on name, type, disease focus, business model and, if applicable, donors of the mHealth interventions, was systematically retrieved from various databases.
mHealth specific databases were screened: (1) the 'mHealth database' from the U.S. Agency for International Development (USAID), (2) the 'mHealth Working Group Inventory of Projects' by the Johns Hopkins University and (3) the 'mHealth Deployment Tracker' provided by the GSMA. In addition, non-mHealth specific databases which collect innovative projects from all over the world were screened: (4) the 'Center for Health Market Innovation' (CMHI) database and (5) the database of 'Global Innovation Exchange'.
The sources of the databases can be found at the section 'Availability of data and materials'.
A web-search was also conducted and webpages of the Ministries of Health in each country were screened.
After the mHealth projects were collected, information on name, type of intervention (classified according to the classification system introduced by Labrique et al [28]), disease-focus, description of intervention, primary source of funding and involved organizations when possible, were retrieved.
Screening of databases was conducted in summer of 2018. The full list of included mHealth interventions (n=343) can be provided by the author upon request.

2.4.1 Literature / Experts

Furthermore, published peer reviewed literature (using google scholar and the MEDLINE database), grey literature (using conventional websearch) as well as legislative texts (e. g. for the analysis of data protection laws) was used.
Moreover, experts from the countries were identified and contacted. The identification was made primarily through published peer-review papers on mHealth (which had already been identified as part of the literature search). The identified persons were then contacted electronically and asked whether they were willing to answer questions about the mHealth activities in their country and, if not, whether they could recommend someone in their country who could. If someone agreed, a questionnaire with a short introduction and aim of the study

was sent electronically (the questionnaire is provided in additional file 1). The questionnaire served as a basis for further correspondence. Any ambiguities about the respective mHealth landscape were iteratively clarified with the experts.

3 Results

3.1 Service Delivery

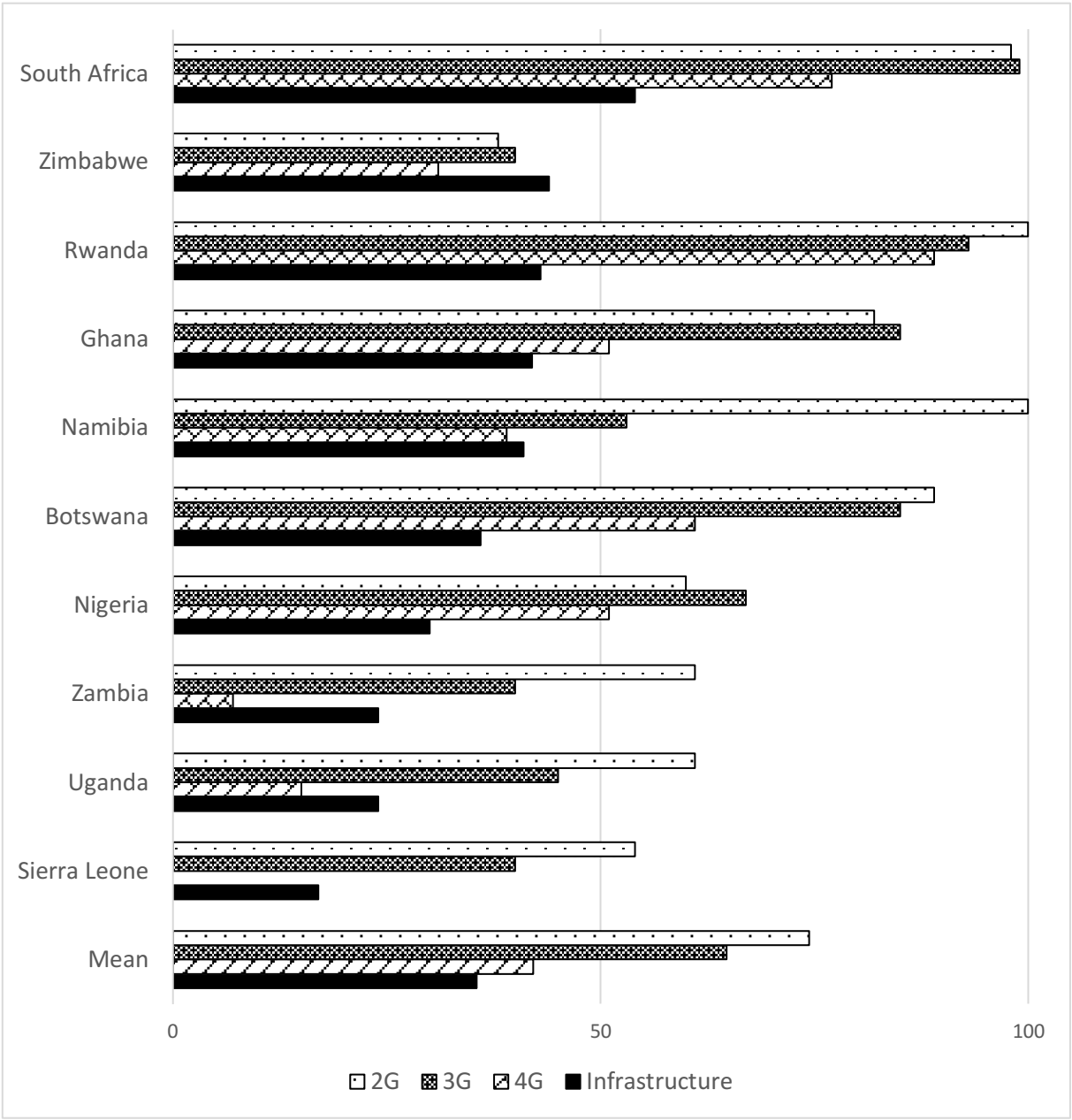
A healthcare system is only as effective as the services it provides. Provided services must respond to populations' health problems and the population must have access to these services. Also, in competitive environments, market regulation is needed that ensures competition while protecting consumer's choice.
Therefore, the following section analyses people's *access to the cellular network,* the *type of mHealth services* offered and the existence of a *competition law*.

3.1.1 Access to cellular network

The most basic form of access to the mobile network is access to the second generation of the cellular network (2G). It allows users to use basic functions (mainly voice calls and SMS) but does not allow fast data transmissions. The 2G coverage is good in most SSA countries and is, according to the 2G-coverage indicator provided by the GSMA, well over 50 (out of a maximum of 100). The average is 74 (figure 2). Some countries have almost complete 2G coverage (Namibia, South Africa and Zimbabwe). The coverage with the third generation of the cellular network (3G), which allows faster data transmissions, is on average lower the than the 2G coverage (65 vs 74). Interestingly, in some African countries the access to 3G is better than access to 2G (Nigeria, Ghana, Zimbabwe and South Africa). The lowest coverage rate has the fourth generation of the cellular network (4G, also known as 'Long Term Evolution' (LTE)). Some countries, e. g. Sierra Leone and Zambia, have just started introducing 4G and therefore have no or very low coverage rates. Other countries have a very high coverage (Rwanda and South Africa). The average 4G coverage in SSA has risen sharply in recent years, from 11 in 2014 to 42 in 2017.

The 'Infrastructure Index' (provided by GSMA) summarizes various parameters that include not only coverage, but also the quality (e. g. stability and reliability of the signal) of the cellular network. Of the countries selected here, Sierra Leone (17) and Zambia (24) have the lowest values, while South Africa (54) and Zimbabwe (44) have the highest. The average is rather low (36), but has continuously improved since 2014.

Figure 2: 'Infrastructure Index' (GSMA) and 4G, 3G and 2G coverage in SSA (scored within a range 0-100; higher score represents stronger performance)

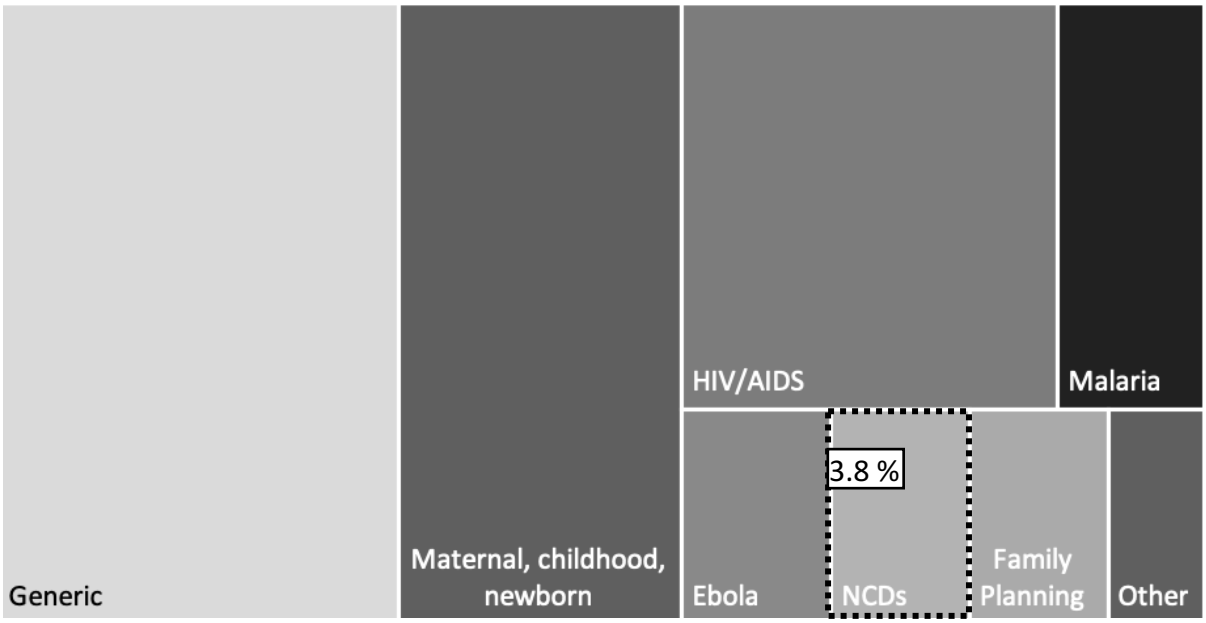


3.1.2 Provided Services

The focus of most mHealth interventions in the past has not been on NCDs (figure 3). Only 4 % of interventions can be classified as exclusively NCD-related interventions. A large proportion (46 %) can be classified as reproductive health, which includes maternal, child and neonatal health (22 %), HIV/AIDS (20 %) and family planning (4 %).

However, there are many generic interventions that do not belong to a specific disease group and that can potentially be used to combat NCDs (e. g. generic mobile phone-based communication tools).

Figure 3: Disease focus of mHealth interventions in SSA (n=343)



Looking at the type of intervention instead of the targeted disease, the vast majority of mHealth interventions (48 %) have been used to provide information to patients. 11 of the 12 possible intervention types have already been used (table 3). The only type of intervention which has not been used so far is the 'electronic decision support'.

Table 3: Type of mHealth interventions in SSA (n=343)

Type of intervention	Number of interventions	%
Client education and behavior change communication	164	47.8
Data collection and reporting	34	9.9
Provider training and education	33	9.6
Provider-to-provider communication	30	8.8
Registries / vital events tracking	27	7.9
Supply Chain Management	22	6.4
Financial transactions & incentives	12	3.5
Electronic health records	6	1.8
Human resource management	6	1.8
Sensors and point-of-care diagnostics	5	1.5
Provider work planning and scheduling	4	1.2
Electronic decision support	0	0.0

3.1.3 Competition law

For maintaining market competition, many SSA countries have started to implement competition laws over the past years [29]. Currently, 6 out of the 10 analyzed countries have an

own competition-law in place: Zambia (since 1994), Zimbabwe (1996), South Africa (1998), Ghana (2000), Namibia (2003) and Rwanda (2010) [30–35].
Uganda is still awaiting approval by the parliament for its competition law [36]. The same accounts for Nigeria, where a federal competition law is underway (since 2016) [37]. Botswana is in the process of introducing a new competition law, since the old law has been regarded as flawed (e. g. there were no criminal liability for cartel conducts) [38]. Sierra Leone does not have a competition law, but it is expected that there will be a law very soon [39].
Furthermore, four countries (Rwanda, Uganda, Zambia, Zimbabwe) are members of the COMESA (Common Market for Eastern and Southern Africa), which is the largest free trade zone in Africa and has a competition law regulation for its members since 2013. The COMESA Competition Commission (CCC) regulates mergers and acquisitions and business malpractices on a supranational level. Therefore, countries still need to have a national competition law with national competition authorities [40]. However, despite all regulatory efforts which have been undertaken in the last years, the effectiveness of competition laws in the countries has to be questioned [41].

3.2 Workforce

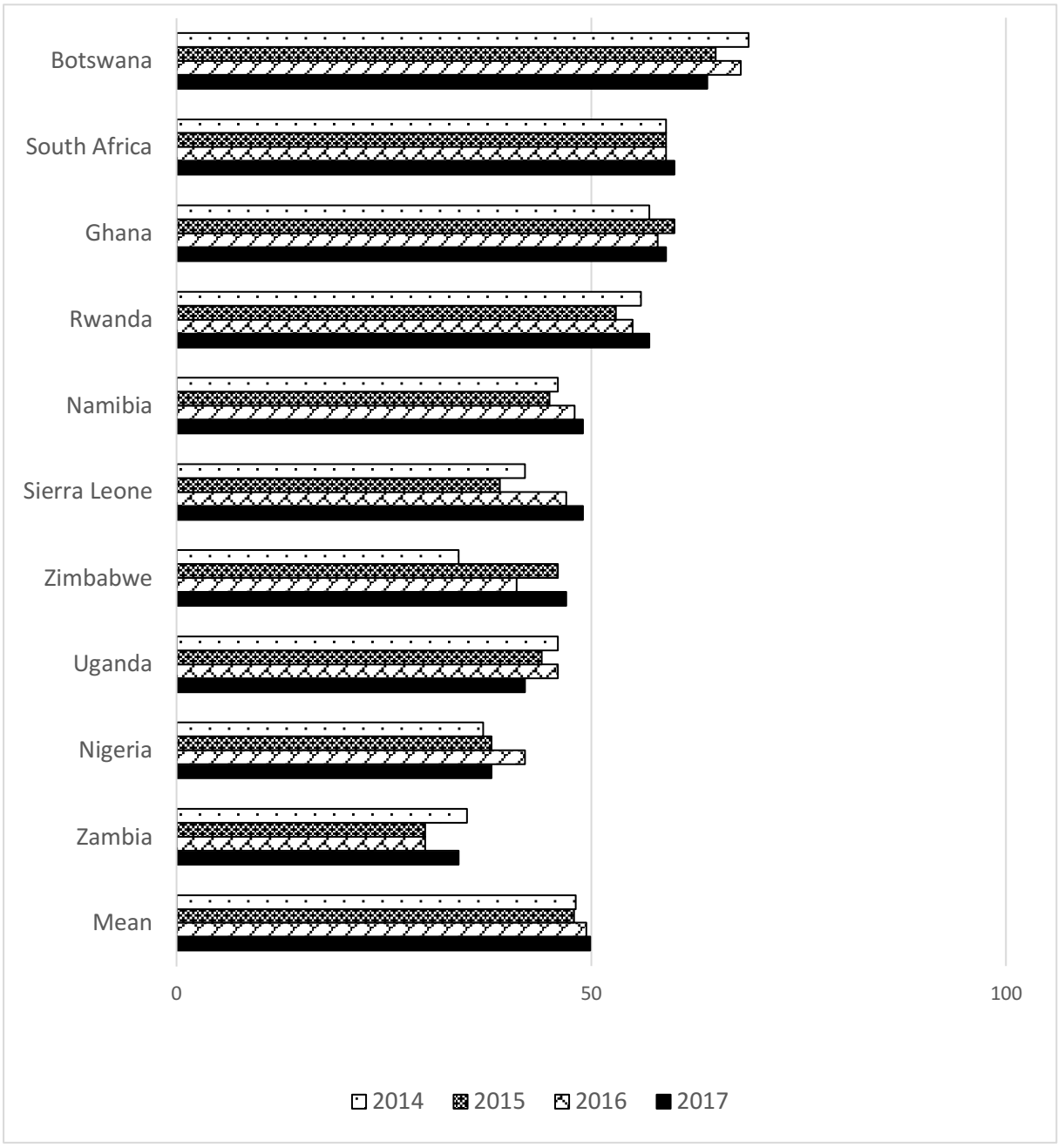
This building block ensures the ability of the health-workforce to provide and use procedures and services. The workforce must match with the requirements for providing health service and the system should support the utilization of these services.
Therefore, the following section will address the *population's familiarity* with mobile phone services, as well as the existence of national *workshops/guidelines* and *financial incentives* which guide/standardize and promote the use of mHealth.

3.2.1 Consumer Readiness

According to the Consumer Readiness score (CR score), which measures citizens skills to use mobile phone and its services (and also includes gender-related aspects that can influence the access to mobile phones) the countries average score is moderately high at 59 (out of a maximum of 100). Sierra Leone (38) and Botswana (44) are the only analyzed countries with a CR score of below 50. The highest scores were measured in Namibia (72), Ghana (73) and South

Africa (75). The development of the average score has been very low within the last years and improved by only one point since 2014 (see figure 4).

Figure 4: 'Consumer Readiness' from 2014 – 2017 (scored within a range 0-100; higher score represents stronger performance)



3.2.2 Workshops and guidelines

In terms of nationwide workshops and guidelines, there is currently no country that provides standardized and centralized workshops for the use of mHealth. It is rather common to train the user of an intervention within a specific project. However, the importance of workshops on the use and implementation of eHealth applications is recognized and mentioned by various

eHealth strategies (Uganda, Nigeria, Zambia, Sierra Leone, Botswana) – but has not yet led to a result.

3.2.3 Incentives

It is analogous with the financial incentives: None of the countries surveyed currently have system-wide remuneration for mHealth. In Nigeria and South Africa, the importance of creating an incentive system is taken into account in their eHealth strategies, but this is not specifically related to mHealth but to all digital applications in the health care system.

3.3 Leadership & Governance

The health systems benefit from governmental and political guidance. National strategies provide important orientations for all stakeholders involved in healthcare [42]. This section analyzes whether there are nationwide strategies for the digitization of the health care systems (e. g. *eHealth strategy*) as well as whether there are specific plans for the integration of mobile phones (e. g. *mHealth strategy*). In addition, it will be examined whether mHealth is regarded as a potential instrument for combating *NCDs*.

3.3.1 eHealth strategy

All countries except two (Namibia and Sierra Leone) have or had a digital Health strategy/eHealth strategy/ICT for healthcare sector strategy, mostly published by the Ministry of Health (in Zambia in collaboration with a development aid agency). However, most strategies are not up-to-date and date back up to 2004 (Botswana) [43–47]. Only 3 countries (Nigeria, South-Africa and Zambia) have a current digital health strategy [48–50].
In Botswana, the eHealth strategy was only part of a larger digitization strategy (eGovernment strategy).

3.3.2 mHealth strategy

With the exception of Botswana, mHealth and mobile phones are mentioned in all eHealth strategies. It is presented as an important tool to remotely educate and support health professional and community health workers (Uganda, Zimbabwe, Nigeria, Rwanda, Nigeria, South Africa), to provide information to patients (Ghana, Uganda, Zimbabwe, Nigeria, Zambia) or to use it for telemedicine (Uganda, Nigeria, Rwanda, Ghana, South Africa). It is also mentioned as a national disease surveillance tool (Zimbabwe, Ghana), as a tool for the collection of patient data (Uganda), for improving the supply chain management (South Africa)

and as an important instrument to reach the goal of a universal health coverage by 2020 (Nigeria).

One country (South Africa) has an independent mHealth strategy beside of the national eHealth strategy [51]. The mHealth strategy contains a comprehensive view on purposes and challenges of mobile phone based health care. In addition to the points already mentioned, the South African mHealth strategy points out the opportunity to re-engineer the primary healthcare system with mHealth (by an improved health delivery at household level).

In addition, many country strategies lack precise, quantifiable targets. Only 3 countries strategies have set (non-NCD specific) target parameters for mHealth.

Nigeria sets target groups (e. g. % of pregnant women and new mothers who receive mobile messages) but does not mention any values for the planned evaluation year 2020. Ghana and South Africa have rather qualitative goals and plan to support further pilot projects but without quantifiable targets.

3.3.3 Inclusion of NCDs

Most strategies do not mention the increasing prevalence of NCDs and the fact that mHealth could reduce the NCD-burden on health systems. Only three countries (South Africa, Uganda, Nigeria) have linked mobile phones to the prevention of NCDs in their strategies. In these strategies it is stated that mHealth could be utilized to educate patients on how to manage their disease. Another countries eHealth strategy (Zimbabwe) recognizes the increasing burden of NCDs but doesn't connect it with mHealth. In most strategies, mHealth is mostly connected with benefits in maternal, newborn, child health care and infectious diseases.

3.4 Financing

Inequalities and barriers to access to the health system and its services should be kept to a minimum. Governments can also promote and stimulate innovative care models.

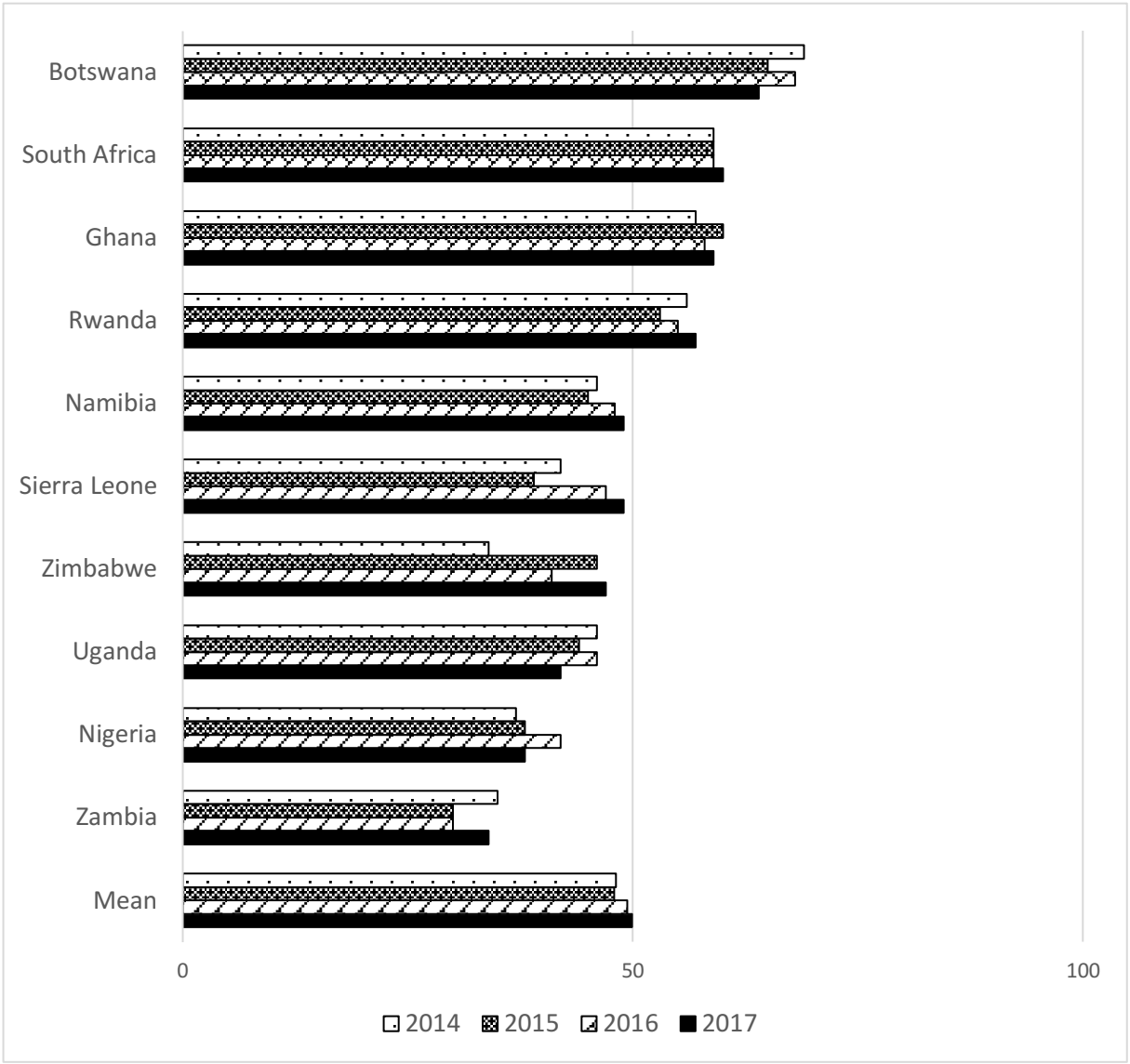
Therefore, the *affordability of mobile services* (telephone, tariffs, etc.) and the *affordability of mHealth interventions*, as well as *government participation* in mHealth projects are analyzed below.

3.4.1 Affordability of mobile services

The affordability of mobile services is reflected by the 'affordability' score provided by the GSMA. The score includes local prices for entry-level phones, costs of mobile tariffs, average income, inequalities in income and cost of taxation and mobile-specific taxation.

The analyzed countries achieve a value of only 50 on average (figure 5). This shows that the affordability of mobile phones and its services is limited for many parts of the African population. In six countries mobile services are even less affordable (meaning a score of below 50). In Zambia the score is the lowest (34). Highest scores were measured in Botswana (64) and South Africa (60) indicating a moderate affordability for most citizens. Overall, the score has only slightly improved in recent years (by 2 points since 2014). In some countries, however, the situation has even worsened (Nigeria, Botswana, Uganda, Zambia)

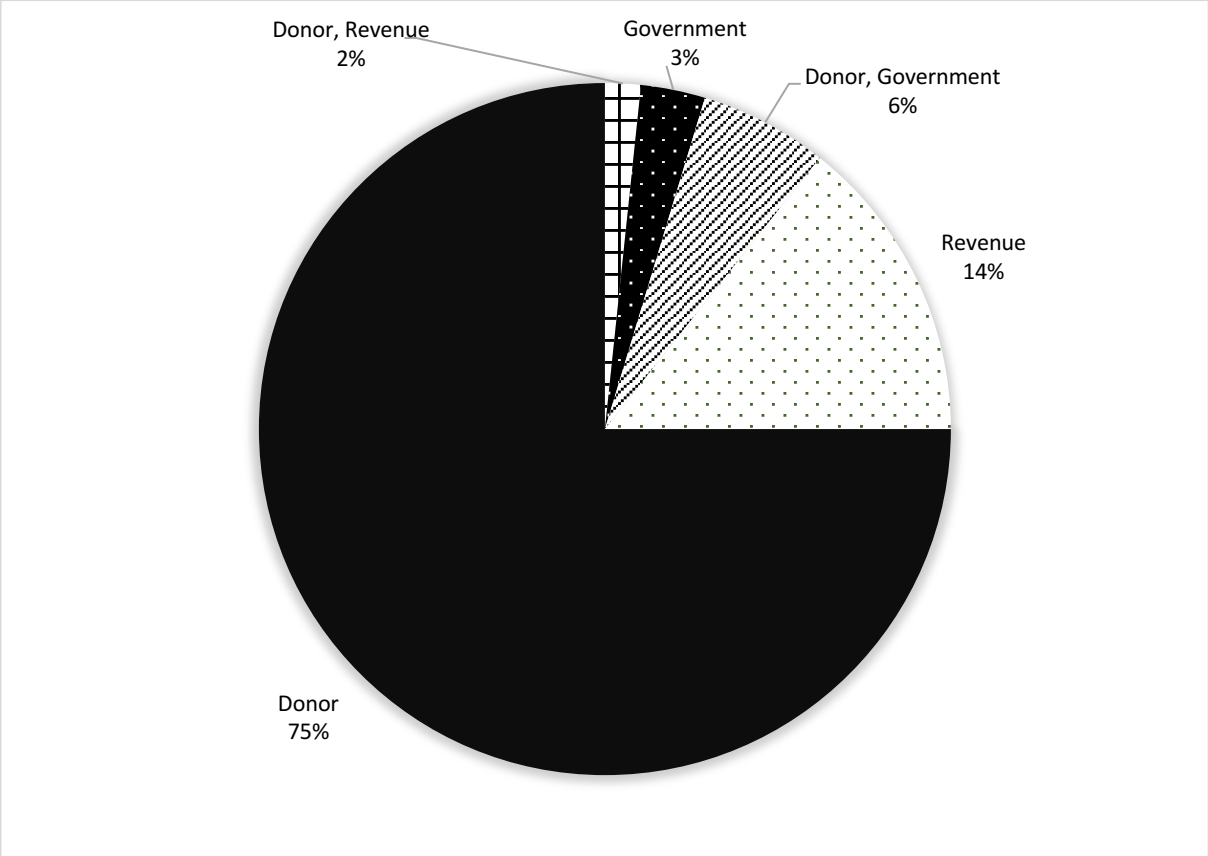
Figure 5: Affordability of mobile services (GSMA) (scored within a range 0-100; higher score represents stronger performance)



3.4.2 Cost of interventions

The vast majority of the mHealth interventions is free of charge. Currently, 84 % of the interventions are donor and/or governmental-driven and therefore generally free of charge for users. However, in recent years, there has been an increase in the number of new mHealth related companies (e. g. start-ups) being set up. These do not function with the help of donations or NGOs but have a business case as a basis and thus are revenue and sales-driven. Some of these interventions run as freemium models (i.e. that the basic functionality of the intervention is free, but the full version must be purchased). At present, 16 % of the interventions are revenue-driven (see figure below) and may therefore include costs for end-users.

Figure 6: mHealth interventions funding sources (n=300)



3.4.3 Governmental involvement

The governmental involvement in mHealth is very low. Among the included countries, the governments are involved in less than a tenth of all interventions. And in many government-backed interventions, additional donors are involved. As stated above the mHealth landscape is very much donor driven: Currently 75 % are purely financed through donation, many come from foreign countries (developing aid agencies, private donations).

3.5 Technologies & Medical Products

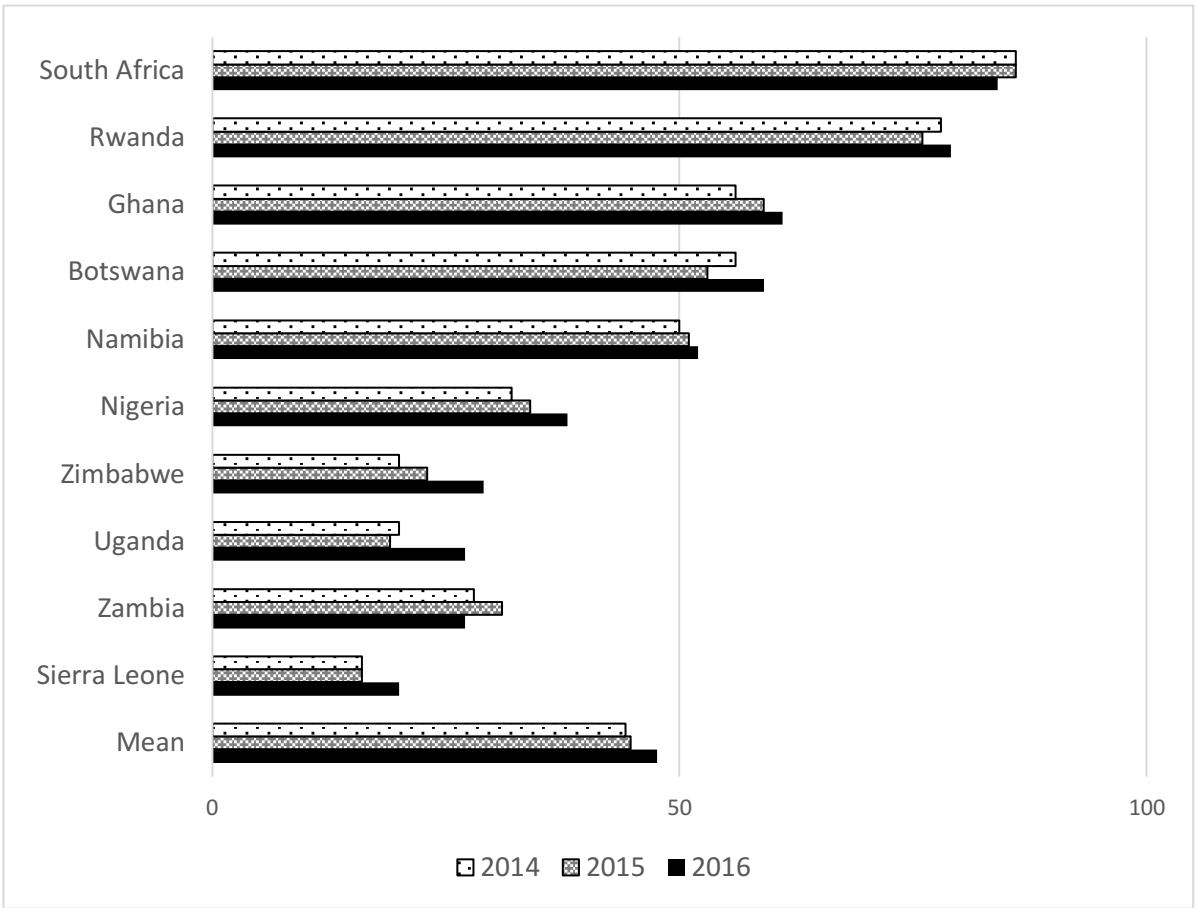
A well-functioning health system ensures the equal access to technologies needed and ensures their quality and safety. Policies are also needed to promote technological innovation that benefits people with chronic diseases.

The access to mHealth is (beside of the access to the cellular network and the affordability of mobile services) determined by the *access to electricity*. Furthermore, in order to ensure the quality and safety of medical technologies, the existence of a *regulatory system for medical devices* will be analyzed and, in order to promote innovation, the *ease of doing business* will be discussed.

3.5.1 Access to electricity

Access to electricity varies widely among African countries. In few countries, the supply of electricity is good, for example in South Africa or in Rwanda (84 % and 79 % respectively of all citizens are supplied with electricity). But in most other countries the access is poor or very poor. In Sierra Leone only one fifth, and in Uganda and Zambia only a little more than a quarter

Figure 7: Access to electricity in SSA [%]



of the population has access to electricity. In total, less than half of the population is connected to the electricity grid and therefore able to charge a mobile phone.

3.5.2 Regulation and Safety

mHealth solutions can cover a wide spectrum of functions and bear different levels of risks for the users. Therefore, sound and effective regulatory systems are needed to ensure the quality, safety and efficacy of medical products and for the promotion of trade and socioeconomic advancement [52]. National Medicines Regulatory agencies (NMRA), similar to the FDA in the US or the EMA in the EU, are needed, which provide guidance and regulation for the distribution of medical devices [53].

According to the 'Global Atlas of medical devices' (published by the WHO) most countries, except for Botswana have a NMRA, which is responsible for the regulation of medical devices. But the NMRAs have varying degrees of capacities. Many are under-resourced and lack of qualified experts to perform critical regulatory functions [54]. This leads for example to long delays before medical products become available to the population, or to an increasing circulation of substandard and falsified medical products. Furthermore, most countries (except for Ghana, Rwanda and South-Africa) do not have a risk class classification system for their medical products, which indicates a rather low development level of medical device regulation.

3.5.3 Policies fostering technological innovation

Innovations, particularly developed by private investments, depend on the regulatory environment. The 'Doing Business report 2018', published by the World Trade Organization (WTO) compares business regulations for domestic firms and is based on parameters such as the ease of getting credits, paying taxes, or how much time it takes to start a business.

The various scores show that the SSA countries differ widely from each other. The SSA region has the widest gap worldwide between the country with the friendliest and the worst business environment.

The average regulatory climate for businesses in SSA is moderate (69 points). But it has steadily improved over the last years, showing that the region is becoming more business friendly.

The SSA region has also introduced many reforms in the last years in order to accelerate business investments. The number of reforms in the year 2017 was the highest worldwide: 31 % of all reforms globally (which were meant to make it easier to do business) were implemented in SSA [55].

3.6 Information & Research

Health systems should ensure correct processing of health-related data and also facilitate the availability of the data necessary for decision-making. Research also contributes to a functioning health system.
Therefore, the existence of *data protection laws* as well as *access to information* on mHealth interventions and cellular network coverage will be considered below. Finally, the scope of existing *research on mHealth* will be analysed.

3.6.1 Data Protection

Of the 10 countries, 5 have currently a data protection law (Botswana, Rwanda, Ghana, South Africa, Uganda) [56–60]. These laws have been introduced since 2012. All laws explicitly take into account the handling of health-related data and how such data has to be processed. 3 countries are right now in the process of introducing a law on data protection (Namibia, Nigeria, Zambia) and 2 countries (Sierra Leone and Zimbabwe) have currently no actions planned to introduce a data protection law. The protection of data in these countries is therefore mostly regulated through the constitutional law.
However, the African continent is making efforts in the area of data protection. The African Union adopted a framework on cyber security and data protection in 2014 [61]. Member states are now free to declare their agreement with the convention. But currently only 10 countries have signed the convention – and before agreed countries need to translate the convention into domestic law, at least 15 of the 54 member states need to declare their agreement.
Moreover, it is worth pointing out that most mHealth projects, which are funded by western donors and development aid agencies, have adopted western-based standards of data protection and thus go beyond local data protection regulation. For example, mHealth projects funded by an EU developing aid agency, usually follow data protection principles given by the General Data Protection Rules (GDPR).

3.6.2 Information access

Currently, there is no centralized database that lists all available mHealth interventions. Online available databases are not comprehensive and not patient-oriented.
Since mHealth usually remains in a project status, information is only given to the respective project participants. However, in some countries (e. g. Ghana and South Africa) governments have started to advertise few of their governmental mHealth interventions. Regarding

information on the available infrastructure – which is also important for developers, such as electricity or mobile cellular network, most countries don't have a detailed database on e. g. dead spots of cellular network coverage in the country. The only country where this already exists is Nigeria. A detailed 'mobile coverage maps' platform provides high resolution layers of who is covered and who is not covered.

3.6.3 Research

All countries except one (Zimbabwe) have published peer-reviewed papers on mHealth (according to MEDLINE). The bandwidth of the number of published articles is very high. South Africa has by far the most published articles (n=118). The second and third most frequent publications on mHealth were from Ghana (n=28) and Uganda (n=26). The number of published articles has steadily increased over the past year (see table 4).

Table 4: Number of published papers about mHealth according to MEDLINE (*published until 10/2018)

	1st author		**Total**	2018*	2017	2016	2015	2014	≤ 2013
Zimbabwe	**0**		**0**						
Namibia	**0**		**2**		1	1			
Sierra Leone	**1**		**4**	1	2	1			
Zambia	**2**		**4**		3			1	
Rwanda	**4**		**5**	3			1		1
Botswana	**4**		**7**	1		3		1	2
Nigeria	**7**		**22**	8	5	6	2	1	
Uganda	**8**		**26**	11	8	2	3	1	1
Ghana	**13**		**28**	8	8	6	4	1	1
South Africa	**75**		**118**	35	33	25	10	9	6
Total	**114**		**216**	**67**	**60**	**44**	**20**	**14**	**5**

South Africa (n=75) and Ghana (n=13) have the highest share of 1st authorships on all publications. The vast majority has been published by researchers from the universities within the countries. Only few were published from non-academic institutions or governmental bodies (e. g. MoH).

4 Summary & Discussion

This working paper has analyzed the current implementation status of mHealth in African health systems in order to identify inhibiting and enabling factors. The focus was on the area of mHealth interventions against NCDs, as the burden of NCDs is constantly increasing and is therefore a growing challenge for the continent and its health systems.

For the analysis, 10 benchmark countries were selected. The health systems were evaluated based on the Building Block concept developed by the WHO. Indicators for evaluating the implementation were primarily derived from the SELFIE framework, a framework for evaluating integrated health care models. Extracted data for the parameters came largely from international databases, the systematic analysis of mHealth projects, literature research and expert surveys.

The most important indicators are summarized and depicted in the *scorecard* below (figure 8).

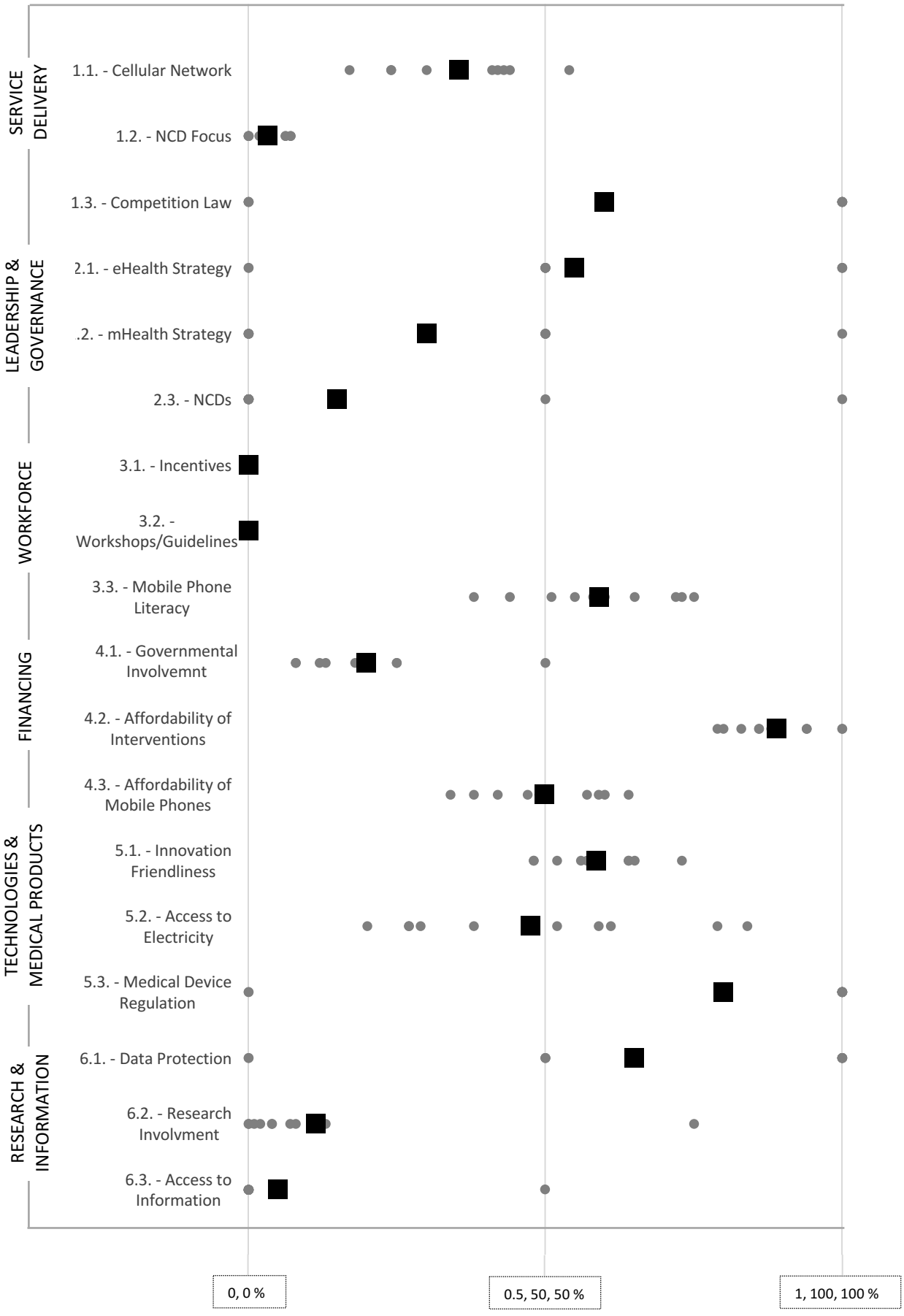
4.1 Service Delivery

Although cellular coverage with the rudimentary 2G network is good and, in some countries, even 100 %, the quality of the networks (including not only coverage but also e. g. the latency rates of data transmissions) is rather low (score of less than 50 out of 100 in most countries). However, the spread of 4G, a newer network-standard with faster download and upload speeds, has strongly increased in the last few years and could therefore contribute to significant improvements of the cellular network in the next years.

Looking at the type of provided mHealth services, most attention has been paid to interventions in the field of reproductive medicine. So far, mHealth interventions against NCDs have not received much attention (they account for only 4 % of all interventions).

In most countries there is also a competition law, which ensures competition in markets. Thus, the law could e. g. contribute in the long term to a user-oriented improvement of mobile networks.

Figure 8: Scorecard of the degree of implementation of mHealth in the SSA health care systems. Squares indicate the average values. Circles represent individual country values. A higher value (in the figure going to the right) means a stronger performance. Explanation of indicators and values below



1.1 - Cellular Network	Quality and coverage of mobile network according to the 'Infrastructure Index' (scored within a range 0–100; higher score represents stronger performance)
1.2 - NCD Focus	% of interventions against NCDs
1.3 - Competition Law	Availability of a domestic competition law (0=no; 1=yes)
2.1 - eHealth Strategy	Published eHealth strategy (0=no; 0.5=yes, but not current; 1=yes, current strategy)
2.2 - mHealth Strategy	Published mHealth strategy (0=no; 0.5=yes, but only part of eHealth strategy; 1=yes, separate mHealth strategy)
2.3 - NCDs Addressed	Focus on NCDs in the strategies (0=NCDs are not addressed within the strategies; 0.5=NCDs are addressed by eHealth strategy; 1=NCDs are addressed by eHealth and mHealth strategy)
3.1 - Incentives	Financial incentives for the utilization of mHealth (0=no; 1=yes)
3.2 - Workshops/Guidelines	Guidelines for the utilization of mHealth (0=no; 1=yes)
3.3 - Mobile Phone Literacy	Citizens ability to use a mobile phone and its services, according to the 'Consumer Readiness Score' (scored within a range 0–100; higher score represents higher performance)
4.1 - Governmental Involvement	% of interventions with governmental involvement
4.2 - Affordability of Interventions	% of interventions free of cost (non-revenue driven)
4.3 - Affordability of Mobile Phones	Affordability of mobile phones and its services, according to the 'Affordability Index' (scored within a range 0–100; higher score represents stronger performance)
5.1 - Innovation Friendliness	Innovation friendliness according to the 'Ease of Doing Business' Index (scored within a range 0–100; higher score represents stronger performance)
5.2 - Access to Electricity	% of citizens having reliable access to electricity
5.3 - Medical Device Regulation	Availability of a regulatory agency for medical devices (0=no; 1=yes)
6.1 - Data protection	Availability of a legislative framework for the protection of health-related data (0=no; 1=yes)
6.2 - Research involvement	Number of published MEDLINE-indexed articles with first author coming from the country
6.3 - Access to information	Availability of information on cellular coverage and/or mHealth interventions in the countries (0=no; 0.5=one or the other; 1=yes)

4.2 Leadership/Governance

All countries except one (Namibia) have recognized the importance and potential of mHealth and provided some guidance for its implementation – mostly within the framework of an eHealth strategy. South Africa is the only country with an independent mHealth strategy. However, many strategies are outdated and lack of quantifiable goals which want to be achieved. In most strategies, the potential of mHealth is not directly linked to the increasing burden of NCDs, but rather as a useful tool to support providers or to provide patients with information.

4.3 Health Workforce

The population's ability to handle mobile phones and services/applications running on them is moderate and has been relatively stable in recent years at around 60 points (out of a maximum of 100).

At present, there is a lack of guidelines and standardized incentive systems for mHealth. There are no guidelines for the health workforce or to patient groups that explain how mobile-assisted interventions should be used. There are also no system wide incentive systems - although the importance of an incentive-system has been identified as a goal in some eHealth strategies. So far, workshops/guidelines and incentive systems for the use of mHealth have been only given within the individual projects.

4.4 Financing

Not everyone can afford to own a mobile phone. The costs for mobile phones and the operating costs are sometimes high. The average-affordability score is 50 (out of 100 maximum points).

The government is only very infrequently involved in mHealth projects and thus leaves the field to the free market and donors from abroad. Since the mHealth landscape is heavily based on donors, most interventions themselves are free of cost. But in recent years the share of revenue-driven interventions has increased (now they account for approx. 15 %), and several business ideas have emerged in the area of mHealth. This development could lead to higher financial hurdles for the use of mHealth in the future.

4.5 Technologies

Access to electricity, which is as necessary for the use of technology as access to cellular network or access to mobile phones, is poor (an average of just under 50 %) – in some countries only about a quarter of the population has access to electricity.
The business environment has improved in recent years. Although the range of business friendliness in the different countries is very wide, the average business climate (e. g. the time it takes to start a business) can be described as moderate.
A regulation system for companies or the products that emerge from such medical technology companies is in place in most countries, but it is questionable whether they have sufficient resources to fulfil all their tasks.

4.6 Research/Information

Currently, 5 of the 10 countries have a data protection law. But most countries, which do not have their own law yet, are currently in the parliamentary process of implementing such a law. It is also important to note that many mHealth projects funded from other countries often follow the data protection standards of the respective funding countries.
In the area of access to information (databases with information on all available mHealth interventions, detailed information on cellular coverage) there is still a lot of catching up to do. There is no centralized database with all available information on mHealth projects in any country. Except for Nigeria, there is no country offering a map with detailed information on the cellular network coverage.
In terms of conducted research, there are considerable differences: in some countries research about mHealth is almost non-existent (Zimbabwe or Namibia) while a country like South Africa has already published much about mHealth.

4.7 Enablers

First, in many countries the mHealth landscape is huge. Some countries hosted up to 80 mHealth interventions over the last years. The importance of mHealth has been therefore mostly **recognized** and all countries except for Namibia have published a digital health strategy (eHealth strategy) and included the importance of mobile phones somehow in the strategy. The existence of such strategies, even if it usually does not receive much public attention, can be seen as an important milestone [62].

It is also positive that some strategies include very **ambitious goals**, e. g. establishing a new model of primary care with support of mobile phones (as proposed in the South African mHealth strategy) or the goal of achieving comprehensive health coverage with the help of mobile technologies (Uganda eHealth Strategy).
In addition, the **regulatory framework has continuously improved** in recent years. Many laws have been or are currently being implemented (data protection law or competition law) and thus constitute important elements for the future patient-oriented development of mHealth. The regulatory framework has also improved for companies, as shown by the 'Ease of Doing Business' Indices and the legislative initiatives in the various countries. As a result, some countries in the SSA region host a rapidly growing **technology start-up ecosystem** that is playing an increasingly important role in the development of digital services [63]. This correlates with the observed increasing landscape of revenue-driven mHealth interventions. The increasing share of revenue-driven interventions could have a very positive effect and solve one of the main problems of the mHealth landscape: lacking sustainability.

4.8 Inhibitors

On the other hand, many factors can be observed that inhibit the expansion of mHealth. Although there are official strategies in most countries, these strategies are mostly afflicted with the problem of **a lack of precise action points** and objectives. Also, there is usually a lack of plans on the continuous monitoring of the implementation and related processes.
The WHO has acknowledged these flaws in such strategic papers and has therefore in collaboration with the International Technology Union (ITU) developed and published guidelines (or toolkit) on how to establish such a digital strategy and emphasizing the importance of monitoring and supervision of the implementation process [62].
In addition, there is **not much attention paid to NCDs**. Neither in the various strategies (NCDs are usually not mentioned) nor in the numerous identified interventions. One reason for the lack of mHealth interventions could be that donor-funded health projects do not always fully respond to health populations needs [6].

In addition, the potential of mHealth is not fully explored yet and only a fraction of possible **types of interventions** are currently used. Almost half of all interventions have a focus on interventions that provide patients with information (e. g. frequently sent SMS for pregnant women with information on the course of pregnancy). But 'Client Education' is only one of 12

different ways to use mHealth [28]. Other important ways of improving healthcare through mobile phones, by e. g. helping in the decision making for health care providers, are not targeted yet by any of the identified interventions. This could be due to the high prevalence of rather simple mobile phones, which offer usually the most basic functionalities (SMS, voice). However, the mHealth landscape will probable become more diverse in the near future, since the increasing adoption of smartphones and so-called feature phones in SSA could make it easier to distribute more complex tools [63].

Another issue is the **lack of financial incentives.** Without incentives it will be difficult to establish certain highly new procedures and interventions into standard care, since the adaption of new technologies is time and resource consuming [64]. A simple provision of such interventions is not sufficient. This could heavily influence the sustainable utilization of mHealth services in the future. Of course, the lack of incentives has to be seen in the light of the overall lack of money and resources in the health care systems.

Beside of the lack of financial incentive systems, there is also a **lack of standardized workshops and/or guidelines** on how to use such interventions (e. g. by recommending specific interventions for certain conditions). These could be developed by national medical associations. They could recommend e. g. how providers can implement mobile phone based tools into their processes. The lack of guidelines and its negative consequences in the widespread use of mHealth has been also acknowledged by the WHO [65].

Also, the **low governmental involvement** in mHealth is striking: in mHealth projects, in stimulation of research, provision of centralized registries/databases or other enabling factors (e. g. cellular network coverage maps). For example: centralized mHealth databases/registries would make it easier for all stakeholder to navigate through the system and also for developers to identify areas with higher needs and opportunities [66].

More governmental involvement could also help to steer the development of mHealth interventions and could accelerate the development of NCD-related interventions. It could further lower financial barriers to mHealth by offering the most important kind of interventions for free and as part of the benefit basket of public health insurance.

Last not least, **lack of good governance** is fostering the challenges. For example regarding the legislation: even those countries that have legislations in place (e. g. for data protection), have often too few regulators to enforce them [6, 67, 68]. Also, there are weaknesses in the

enforcement and monitoring of the medical device market, because most NMRAs in SSA are understaffed and under resourced. Therefore, the medical device market is not properly regulated and the quality and safety of marketed medical devices can not be ensured. This has not been of great importance for previous mHealth interventions. But it is foreseeable that mobile phones and therefore mHealth interventions will be able to perform increasingly complex (e. g. diagnostic) functions, which could therefore pose a higher risk potential for its users.

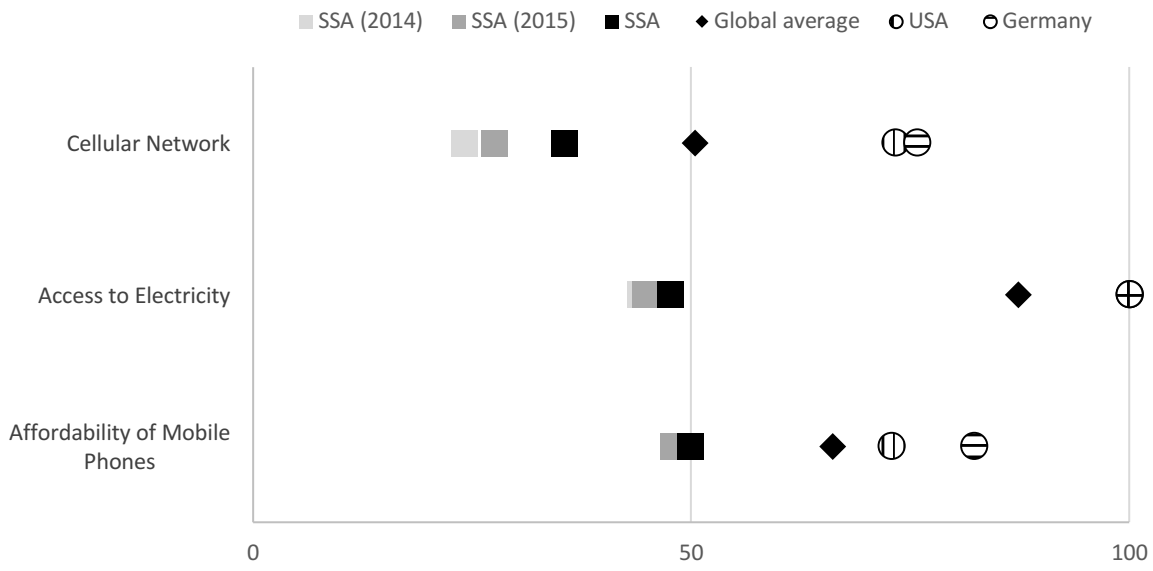
4.9 Access to mobile phones

One of the most critical components for the adaptation of mHealth is the access to the technology [69]. The access to mobile phone technology is usually enabled by 3 factors: (1) the costs for buying a mobile phone and for using it, (2) the access to electricity in order to charge the phone, and (3) the access to the cellular network (2G, 3G or 4G). Figure 9 shows the scores for these 3 factors for SSA (which were already presented in the scorecard above) and compares them with scores for Germany, the USA and the global average. It further depicts the development of the indicators in SSA since 2014.

A direct comparison shows that the scores for SSA in all three areas are far lower than the global average. And compared to highly developed countries such as the USA or Germany, the access to electricity and the quality of the cellular network are only half as good in SSA.

The biggest gap is in the area of **access to electricity**. In many SSA countries, less than half of citizens have a reliable access to electricity. And since 2014 this situation has improved only slightly. This poor access to electricity is considered as one of the major prerequisites for a further uptake of mobile phones [70–72]. However, this limitation may not be as important as it has been assumed so far. There are creative solutions which have been developed to bypass this shortage: One example is the use of car batteries for charging phones [73]. Another example is the use so called feature phones. Feature phones are a mixture between smartphones and conventional cell phones, but less complex than smartphones, more affordable and, especially, more durable [74]. These *African solutions* (e. g. using more durable and less complex phones, bypassing shortages) demonstrate that it is not always necessary to adopt Western standards to ensure access to a technology.

Figure 9: Factors influencing the access to mobile phone technology in SSA, Global Average, Germany and the USA (a higher score represents stronger performance; explanation of indicators and values below)



Cellular Network	Quality and coverage of mobile network according to the 'Infrastructure Index' (scored within a range 0–100; higher score represents stronger performance)
Access to Electricity	% of citizens having reliable access to electricity
Affordability of Mobile Phones	Affordability of mobile phones and its services, according to the 'Affordability Index'

Compared to other regions in the world, the **cellular network** is not as good as it may be assumed (considering the increasing subscription rates in the region). The quality and reliability of the mobile network is significantly driven by the backbone telecommunication infrastructure in Africa. This includes e. g. the international connectivity, the national telecommunication backbone and the last mile. Although there have been enormous investments over the last years to this infrastructure (e. g. in submarine cables and Internet Exchange points (IXPs)), many infrastructure components continue to pose a challenge to access, and African countries are required to make more investments. [75, 76].

The **affordability** is the best of all measured scores and moderate. Financial barriers prevent people particularly from rural areas of owning a mobile phone. But not owning a mobile phone does not necessarily mean to not have access to a mobile phone. In SSA it is not uncommon to share mobile phones among the communities or families [77].

If all factors (the cellular network, access to electricity and affordability of mobile phones) will continuously improving over the next years, an essential requirement for the uptake of

mHealth will be ensured. Once access is ensured, the services offered must also be user-friendly designed and adapted to cultural conditions of the users (cultural factors and the inertia of the users must be taken into account) [69].

4.10 Strengths and limitations

The major strength of this research is its holistic view. It combines and analyzes several important factors that are crucial for the system implementation of mHealth. The framework is able to easily depict inhibiting and enabling factors. It could be further very useful for conducting longitudinal analyses and to observe and monitor the implementation-process of mHealth in SSA.

Another strength is the method used for the framework development. Indicators were systematically discussed and reviewed together with a WHO building block expert (VeS). However, a limiting factor could be that the framework might be non-comprehensive and does not cover all relevant indicators.

Also, the underlying parameters which have been identified as part of the SELFIE framework were developed for assessing integrated care models for patients *with multimorbidity*. But the focus here is not on multimorbidity but on NCDs. This was kept in mind when indicators were discussed and chosen.

Moreover, it was difficult to identify experts who had a comprehensive overview of the mHealth landscape in their country. However, answers by the experts were always crosschecked with grey literature and other available published sources. Therefore, most results presented rely on databases or literature.

Furthermore, the framework and the analysis subsume all analyzed countries under one region. Although it is quite common to generalize and to use terms such as 'Sub-Saharan Africa', the region is not very homogenous. SSA subsumes 48 countries (for comparison: the EU has 27 countries). Some countries have a low HDI, other countries have high HDI. These discrepancies can be seen in the scorecard and some indicators (e. g. research involvement).

5 Conclusion

First, the African mHealth landscape lacks steering and monitoring.
In some countries the number of implemented projects is extremely high. But these are usually donor driven and the governments are not involved. There is no support for the utilization of mobile phones for health, e. g. by providing guidelines or incentives. In addition, only few governments have formulated a mHealth strategy with tangible goals.

Second, mHealth against NCDs is still in its infancy.
Although the burden of NCDs is increasing and already accounts for more than one third of all deaths in SSA, there are only very few mHealth interventions targeting NCDs. Moreover, the published eHealth or mHealth strategies do not address NCDs.

Thirdly, access to mobile phones and the cellular network is moderate.
The cellular infrastructure and especially the poor access to electricity inhibit the access to mobile phones and therefore the uptake of mHealth. However, the quality of the cellular infrastructure has increased considerably in recent years and the poor access to electricity could be bypassed with *African solutions*.

Last but not least, the rapidly growing technology start-up ecosystem in some African countries is promising. mHealth solutions developed by private companies play an increasingly important role in the development of digital services. Their participation in mHealth could lower the problem of donor-dependencies and lacking sustainability.

6 Availability of data and materials

'Mobile Connectivity Index 2018 – Global Scores' by the GSMA:

https://www.mobileconnectivityindex.com/

'World Fact Book' database by the Central Intelligence Agency:

https://www.cia.gov/library/publications/the-world-factbook/

'Ease of Doing Business' Report, by the Worldbank:

http://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB2018-Full-Report.pdf

'Global atlas of medical devices' by WHO:

https://www.who.int/medical_devices/publications/global_atlas_meddev2017/en/

'mHealth database' by the U.S. Agency for International Development:

http://www.africanstrategies4health.org/mhealth-database.html

'mHealth Working Group Inventory of Projects' by the Johns Hopkins University:

https://www.mhealthknowledge.org/resources/mhealth-compendium-database

'mHealth Deployment Tracker' by the GSMA:

https://www.gsma.com/mobilefordevelopment/m4d-tracker/mhealth-deployment-tracker/

'Center for Health Market Innovation' database: http://healthmarketinnovations.org/

'Global Innovation Exchange' database: www.globalinnovationexchange.org/innovation

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Appendix

Additional file 1: Questionnaire sent to experts

Expert survey:

The implementation of mHealth in sub-Saharan African countries

The utilization of mobile phones for preventing and managing diseases has proven to be effective, especially in sub-Saharan African countries. At the same time the need for such a technology which supports the provision of healthcare is very high. This applies particularly for people with chronic and non-communicable diseases, which are expected to become much more prevalent over the next years. However, although the efficacy of mHealth has been proven and the technology is needed, African health systems are lacking to implement mHealth into their health systems. Most mHealth projects remain in a project-status and are not scaled to a national level. Therefore, this questionnaire wants to identify current gaps in the implementation process of mHealth in your country. As part of our literature review, we have identified several factors, which are necessary for a sustainable, nation-wide implementation of mHealth interventions. These factors have been translated into questions which are listed below. **Please feel free to answer the questions with short key points or either yes or no**. If you can recommend any literature (scientific, reports etc.) feel free to refer to it.

Thank you very much in advance,

Victor Stephani
Department of Health Care Management, Technical University of Berlin, Str. des 17. Juni 135, 10623 Berlin

(1/6) **Leadership & Governance**	
Is there a current national digital strategy/agenda (e. g. eHealth strategy)?	
Is mHealth specifically included in the strategy?	
If yes, what are the major aims regarding mHealth?	
Is the government committed to the achievement of their aims / Have they so far reached their goals?	
Are there currently any mHealth interventions which are funded and/or implemented by the Ministry of Health?	

(2/6) **Health workforce**	
How is the health personnel being paid for using mHealth / what are the incentives for the health personnel to use mHealth?	
Are there national guidelines/norms/workshops etc. on how to utilize mHealth?	

(3/6)**Health Care Financing**	
Is there any financial support for the implementation of mHealth interventions by the Ministry of Health?	
Who or which institution is the biggest funder of mHealth interventions?	
Are there financial barriers for using mHealth interventions?	
Are expenditures for mHealth programs reviewed (e. g. by an accounting control)?	

(4/6) **Service Delivery**	
Do all people in need have free access to the relevant mHealth interventions?	
Does the Ministry of Health has close links to the industry or the 'Ministry of Technology' (in order to stimulate integration and collaboration)?	
What disease-focus do most mHealth interventions in your country have?	
Do the mHealth programs use a patient-centred approach?	

(5/6) **Information and research**	
Is there a legislative framework for the protection of (health-related) data?	
Are current policies stimulating research on mHealth?	

(6/6) **Medical products, technologies**	
Is there an innovation-friendly environment for private companies/start-ups etc.?	
Is there a regulatory system for marketing mHealth? (e. g. is mHealth a medical product which needs to be certified by an independent institution comparable to the FDA in the USA)?	

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Effective and needed, but not used: Why do mobile phone-based health interventions in Africa not move beyond the project status?

Reviews have shown that mobile phone-based health interventions (mHealth interventions) are capable of improving health outcomes of patients in Africa, particularly for patients with chronic diseases such as non-communicable diseases (NCDs). But currently, most mHealth interventions are stopped after the pilot and the funding of the donors has ceased. The aim is to identify the reasons for the lacking integration of mHealth interventions against NCDs in sub Saharan African health systems.
10 countries from sub-Saharan Africa (SSA) were selected for the analysis. For the assessment a catalogue of indicators was developed. Data for the indicators was gathered from various sources: databases, literature reviews and expert interviews.
mHealth against NCDs is still in its infancy. Inhibiting factors for the further uptake of mHealth are the lack of specific action points by the governments, the missing attention paid to the rising burden of NCDs, the non-utilization of the full potential of mHealth, the lack of financial incentives and standardized workshops/guidelines and lack of good governance. The access to mobile phones is also inhibited by the poor electricity infrastructure.
Enabling factors in many countries are numerous published eHealth strategies, constantly improving legislative frameworks (such as data protection laws) and a growing technology start-up ecosystem.

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