

Leveraging ubiquitous and novel technologies as enablers to address Africa's health challenges

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ABSTRACT: The last decade has witnessed massive growth in the African economy, accompanied by an unprecedented uptake of novel communications technologies across the five sub-regions. At the same time, the burden of various diseases – both communicable and non-communicable – is also escalating. Thus, the objective of this research was to analyze and highlight uncommon applications of novel technologies toward healthcare delivery in Africa. To this end, we conducted secondary research on the main health concerns and interviewed domain experts in five countries (representing the five sub-regions), namely, Egypt, Democratic Republic of Congo, Kenya, Nigeria, and South Africa. We found that mobile phones and related advanced technologies are already enabling a multitude of services, including health-worker capacity building, medicine and medical equipment delivery, data collection and disease surveillance, emergency medical response, and health promotion and disease prevention. However, the general approach employed for deploying these technologies does raise some concerns, particularly regarding data privacy. Finally, we find that the healthcare stakeholders (pharmaceutical companies, governments, patients, physicians, etc.) must cooperate in order to take advantage of these low-cost technological breakthroughs for themselves and, more importantly, for the health of the patients.

KEYWORDS: Africa; healthcare; mhealth; mobile; technology.

1 INTRODUCTION

Africa's economic situation today is unique. While BRIC¹ countries represent nations undergoing rapid, peaceful, asymmetrical evolution of their financial foundations, Africa is displaying this change across an entire continent. The sheer variety of both opportunities and challenges this brings mean that traditional Western interaction models, built in the boardroom or by academia are destined for failure in such a heterogeneous, dynamic environment. All over the world, new technologies are quickly being appraised by healthcare stakeholders to gauge their utility in enhancing populations' welfare. Of course, this is not limited to the developed nations with existing technological infrastructure: Africa, in particular, being the next giant of wealth creation, possesses a burgeoning appetite for technology and, especially, mobile-phone-based solutions. The developed countries information seeking behavior has gone successively from desktop to laptop, and then to mobile phones. In contrast with this traditional model, the emerging world, mainly Africa accessed to information directly through mobile phones and is expected to continue there for at least a while. But how could these cutting-edge technologies serve the goal of guaranteeing access to healthcare for all on the continent?

¹ Brazil, Russia, India, and China

In this paper, we investigate the opportunities that these technologies represent in terms of improving healthcare access. We first discuss the potential of Africa as a future economic powerhouse and present real data to highlight this promise. We then present several cases studies from Africa which demonstrate best practices in exploiting technology for healthcare access. Specific examples are discussed from nations that are representative of each sub-region of Africa: the Arab Republic of Egypt, the Democratic Republic of Congo (DRC), the Federal Republic of Nigeria, Kenya, and South Africa. Finally, we reveal the viewpoints of experts currently working in the field to capture what data we might have missed and explore upcoming events in new technologies.

2 AFRICA: DEFEATING FATE AND UNVEILING WEALTH

Gone are the days when Africa could be passed off as a poor and hopeless continent. Today's economic indicators show the true promise of Africa as the world's next growth leader.

Over the last ten years, in particular, Africa has shown constant and positive growth in the gross domestic product (GDP), leaving in its wake all the OECD countries as well as North America and Japan – even after discounting for the financial turmoil of 2008. Indeed, on an average, Africa has shown a real GDP growth of more than 5% since 2004. During the financial crisis, when most high-income countries reported negative growth, Africa stood out and kept growing (figure 1). In 2012, five of the world's ten fastest growing economies were in Africa [1]: Sierra Leone, Niger, Liberia, Burkina Faso, and Cote d'Ivoire.

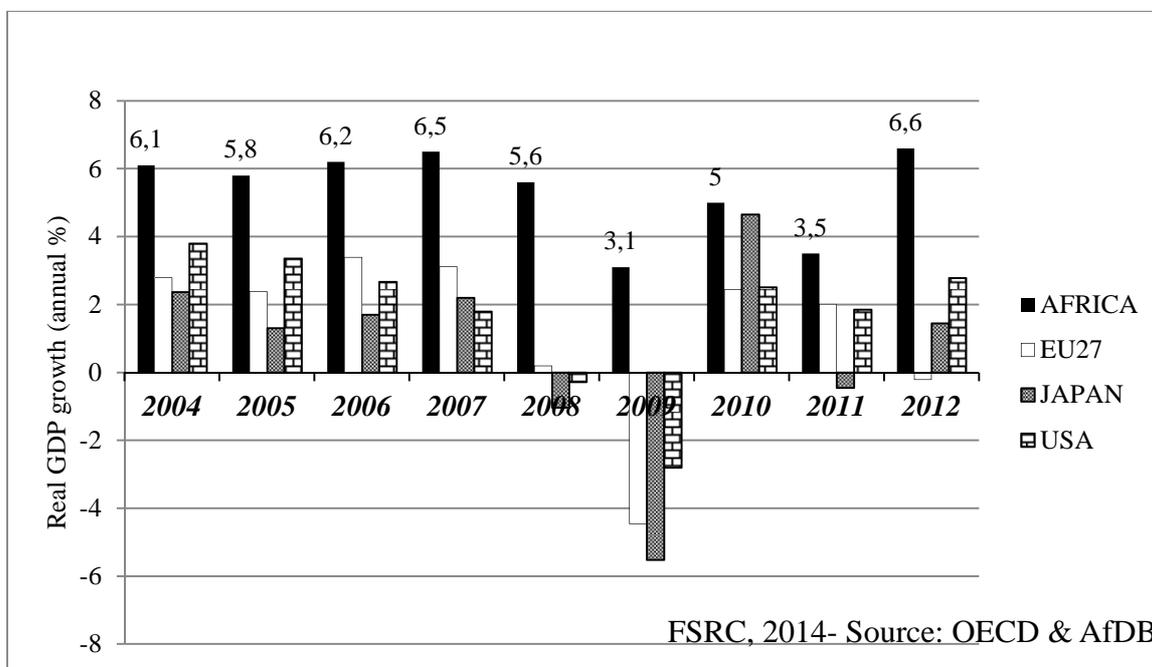


Figure 1: Real GDP growth of Africa, EU-27², Japan, and USA since 2004.

Complementary to this growth, African countries are seeing real wealth creation and nation building. According to the African Development Bank Group which is a multilateral development institution, the GDP of the continent exceeded US \$2 trillion in 2013 (figure 2).

As shown in figure 2, the African GDP and its real growth have seen a constant increase and from 2004 – wealth in Africa more than doubled in these 10 years.

² EU-27 includes Belgium, France, Italy, Luxembourg, Netherlands, Germany, Denmark, Ireland, United Kingdom, Greece, Spain, Portugal, Austria, Sweden, Finland, Malta, Cyprus, Slovenia, Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Romania, and Bulgaria.

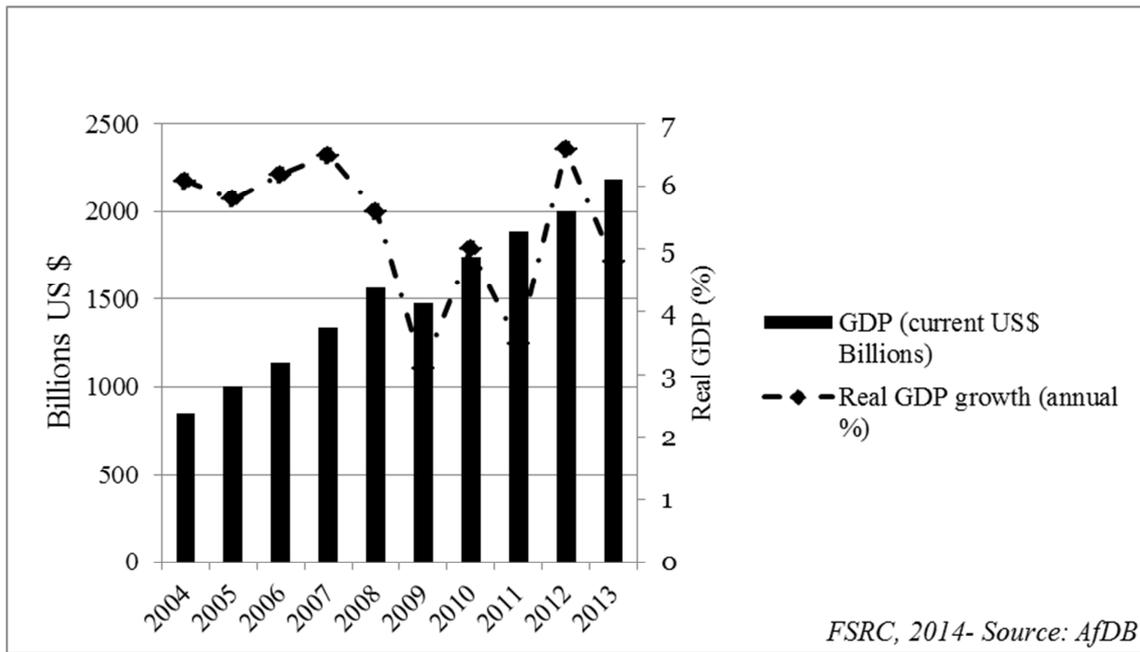


Figure 2: Africa GDP and annual growth

Moreover, this huge increase in wealth has trickled down to per capita incomes, which has also almost doubled during the same period.

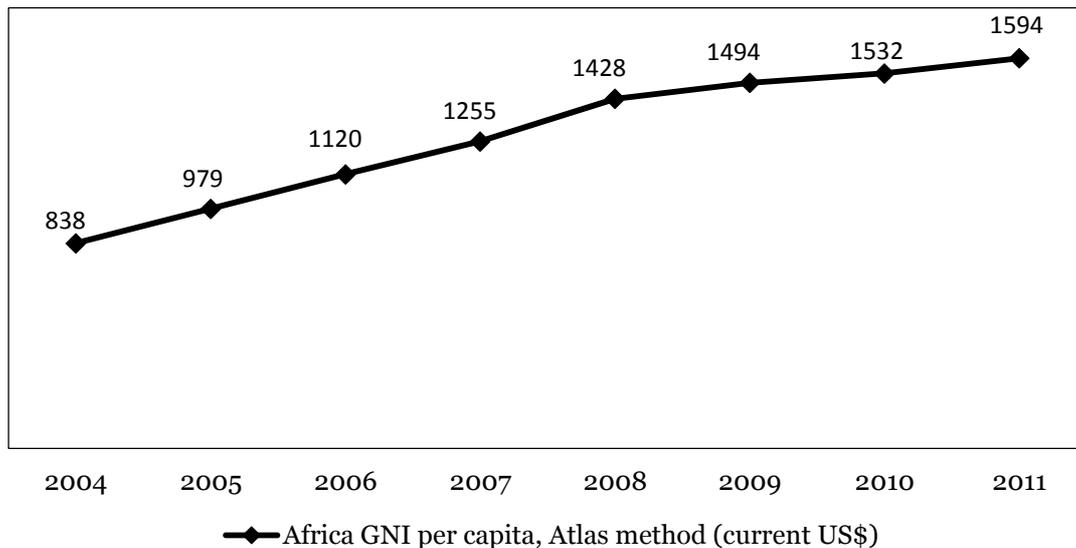


Figure 3: GNI per capita Current US \$

In addition to the GDP growth, one must still consider the traditional appealing advantages of Africa: the fecund soil and the vast unexploited natural resources [2]. As a result, the foreign direct investments (FDI) in African nations increased by 6.8% in 2014, reaching an estimated US \$56 billion last year. South Africa alone received nearly a fifth of the FDI [3][4], while Nigeria (the second-largest African oil exporter with 3.1% of global reserves[2]) attracted US \$4,142 million to take second place.

Thus, in contrast to the apathy of the past, investors today see Africa as a concrete opportunity with a pragmatic business environment. In 2013, the World Bank’s *Ease of Doing Business* index ranked 15 African countries before India, 10 before Brazil, and 9 before China and Russia[5].

The rise of Africa should be viewed not simply from the narrow lens of existing financial resources, but also from the viewpoint of the large, untapped opportunity that it represents. The scale of Africa is vast, as shown in figure 4. Alone, the continent is larger than the USA, China, Japan, India, and all of Europe combined. The 53 countries are populated by 1.033 billion potential consumers with Nigeria, Ethiopia, Egypt, the DRC, and South Africa each accounting for 173.6, 95.0, 82.1, 67.3, and 52.9 million inhabitants, respectively.

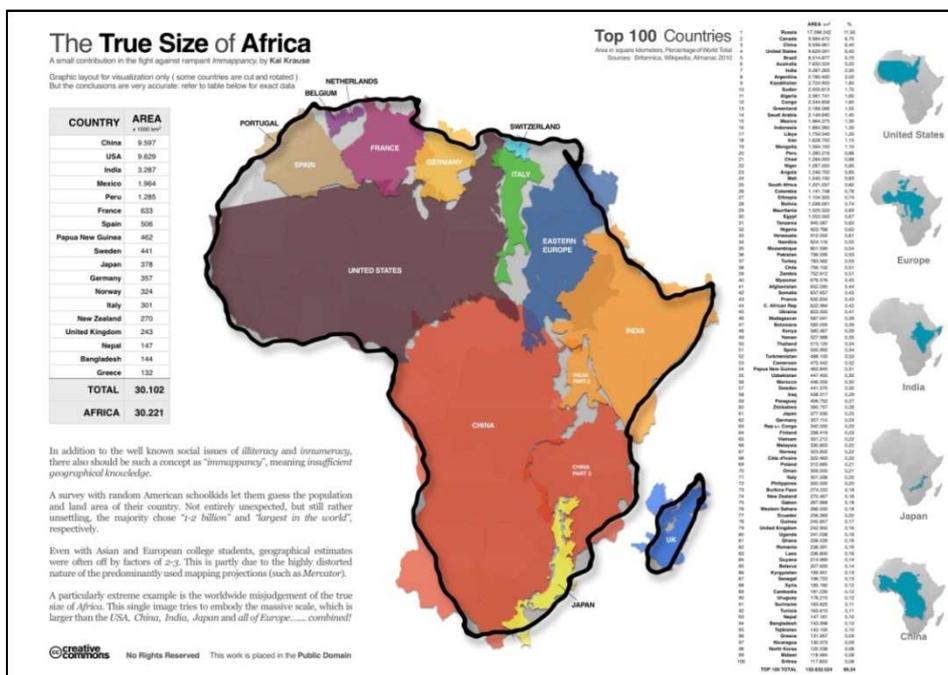


Figure 4: Geographical scale of the African continent (Image credit to Kai Krause)

Sixty-five per cent (65%) of its population is under the age of 35 and over 35% are aged 15–35. Such youth shows not only the tremendous scale of the consumer market and available human capital but also the advantages of early adoption of newer technologies.

3 CAPITALIZING ON TECHNOLOGIES TO IMPROVE LIFE

As in any other part of the world, information technology, accessed mainly through mobile phones, has become an integral part of millions of Africans' daily life. The palpable interest in mobile phones, in particular, stems from the new affordability of such devices in these emerging markets, where the common man has never previously been able to afford traditional means of access to information. Even today, very few have access to desktop computers through which they can obtain lifesaving information. In such a context, mobiles phones constitute, fortunately, critical solutions.

“Mobiles, in a certain way are all about information...The rest of the emerging countries is making their way through it...they constitute an immense part of the emerging markets portfolio”

Jawahar Kanjilal, eMobile and ICT for Development expert, creator of Nokia Life Tools

In 2013, the total subscriber base for mobile cellular services in Africa reached an estimated 545 million[6]. In other words, mobile phone penetration grew from just 12.4% in 2005 to approximately 80% in 2013 – comparable with the growth seen in Asia[6]. However, this overall performance conceals some differences at the individual country level. For instance, Nigeria, Kenya, and South Africa stand out of the crowd with household mobile phone penetration rates of 139%, 120.7%, and 228.5%, respectively[7]. Such unseen growth, which started in the 2000's, hinges on the affordability of handsets and mobile network services. In fact, in several countries such as Nigeria, mobile network operators actually offer SIM cards for free.

“As soon the opportunity came, the uptake was immediate. People quickly noticed the contribution mobiles would have not only on communication but also in terms of business and even healthcare”

Emeka Opera, Director of Corporate Communications & CSR, Airtel Nigeria

Such penetration rates have captured the imagination of governments, non-governmental organization (NGO), and multinational organizations. These institutions are putting focused strategies in place to capitalize on mobiles to address public issues in Africa. Among these issues, healthcare, in particular, has seen a significant amount of innovation that aims to solve the challenges faced by healthcare stakeholders. In fact, data retrieved from the Center for Health Market Innovations (CHMI) points out that 71% of the 1,223 innovations being implemented across the world are located in Africa, as on 26 May 2014.

Despite these developments, healthcare in Africa still represents a daunting challenge, with many barriers to health promotion and disease prevention, data collection and disease surveillance, emergency medical response, healthcare system monitoring and evaluation, training healthcare workers, treatment compliance, and medicine and medical equipment delivery in hard-to-access areas.

“We are facing numerous challenges that jeopardize populations’ health, mainly access to medicines, including availability, remoteness due to weak infrastructure, and low access to technologies.”

Cléophas If MALABA MUNYANJI, Director of Health Laboratories, Ministry of Health, DR Congo

In the following sections, we present case studies that highlight best practices in exploiting such technologies to solve a specific health issue within a specific country. We cover five countries that are representative of the five sub-regions of Africa.

4 CASE STUDIES ON BEST PRACTICES FOR TECHNOLOGY IN HEALTHCARE

4.1 DEMOCRATIC REPUBLIC OF CONGO (CENTRAL AFRICA)

Located in the African Great Lakes region, the Democratic Republic of Congo (DRC) is the second largest country in Africa with a population of 67.5 million (in 2013)[8]. The DRC is notable for its exceptionally rich soil that is often explained away by geologists as a “geologic scandal.” Since 2010, it has registered an annual GDP growth rate of above 6%, suggesting considerable scope for improving welfare among its population[8]. However, the recent human catastrophes – in particular, the civil wars – have rendered the DRC health system weak and vulnerable. In 2007, only 5,967 public health workers remained in the country, with the rest fleeing to Western or neighboring countries. This left only 1 physician for every 11,731 people [9] and the consequences were devastating: The infant mortality rate is 108.1 deaths per 1,000 live births (one of the highest in the world) and the life expectancy at birth is only about 50 years[8]. Moreover, the urban population represents only 35.4% of the nation, with the majority still in remote and hard-to-access areas[8]. Of course, the recent political unrest has only exacerbated these problems leading to a repulsive transportation infrastructure. In turn, this transportation barrier partly explains the low productivity of the industrial sector and the low healthcare delivery rates. In 2010, the DRC’s maternal mortality rate stood at 477 deaths per 100,000 live births – this is in stark contrast to Western levels such as 20 in the USA and only 5.7 in Norway[10]. Furthermore, only 79% of births are attended by skilled health staff in contrast to most developed countries, where 100% attendance is taken for granted.

Given this background, it is quite edifying to explore native technological solutions to the challenges faced by healthcare workers in terms of quantity, quality, and access. Two technologies, in particular, are promising.

- **Heberden telemedicine system[11]**

Delivering the correct healthcare services to the patient, that is, bridging the last mile, is the greatest issue today, especially for diseases that affects most developing countries. Telemedicine directly bridges the gap, allowing better access to healthcare for even the most remote patients.

Health issues targeted: All

Focus areas: Health worker capacity building, Emergency Medical Response

Technology requirements: Tablet, Laptop and Internet

Opportunities:

- Cost reduction from decrease in patients’ transfer/ referrals
- Improved healthcare quality
- Capacity building: training health workers for greater efficacy

The Heberden Telemedicine System allows doctors at faith-based hospitals in developing countries to consult with doctors in the US, Israel, and Europe. The system also incorporates a cloud-based electronic medical records system. Considering the geographic position of the DRC, such an initiative will be pivotal in enhancing healthcare systems across Central Africa.

Drones prime air™[12]

Health issues targeted: All

Focus areas: Medicines and medical equipment delivery

Technology requirements: Drone, GPS

Opportunities:

- Medicines and medical equipment delivered via drone to any place
- Facilitation of basic interventions and improved access to healthcare in rural areas

In general, the majority of patients seeking healthcare require only the correct medicines for a complete cure. Moreover, even when surgical interventions are indicated, light-weight (<500 g), basic tools are often the most needed, such as bistouries, scalpels, needle holders, forceps, and surgical drapes. However, in many cases in the developing world, access to even these basic medicines and medical equipment is a major concern.

The broad utility of unmanned flying drones is best illustrated in Amazon's drone-based delivery project, Prime Air™. Regardless of Amazon's commitment to the project, it is very obvious that this method represents a serious solution for delivering drugs or medicine to hard-to-access areas. In fact, Amazon publicly claimed that packages can be delivered exactly to the location provided within 30 minutes. As for now, the drone-based delivery industry is still at its infancy and requires aviation regulations to be in place[13]. Nevertheless, drones retain considerable attention and the idea of their widespread use in developing countries is compelling.

4.2 ARAB REPUBLIC OF EGYPT (NORTH AFRICA)

With a rich history, the Arab Republic of Egypt is today one of the most populous African countries with a diversified economy spread almost equally (in terms of productivity) across sectors such as tourism, agriculture, industry, and services. Of the 82.1 million Egyptians living in the country in 2013, approximately 43.8% live in urban area[8]. Notwithstanding the Arab spring and the ongoing political unrest[14], Egypt retains a GDP of about US \$270.953 billion and an annual real GDP growth slightly above 2%. As of 2013, the infant mortality rate is 18.5 deaths per 1,000 live births and the life expectancy at birth is about 71.2 years[8]. The physician density was 2.83 per 1,000 in 2009[15], which is certainly not low. However, the country carries a noticeable burden of non-communicable diseases (NCDs). Actually, in 2008, NCDs were estimated to responsible for 82% of all deaths in Egypt[16]. Tobacco use, in particular, is the top contributor to this prevalence of NCDs in the country, according to the WHO[17][18]. Indeed, a recent survey revealed that 19.4% of Egyptians (9.7 million) smoke and 95% of these are active smokers; men smoked, on average, 19.4 cigarettes a day[19]. Interestingly, according to the WHO in 2009, 64% of total health spending occurred in private facilities[15]. This illustrates a sensitive awareness and political will to support healthcare in Egypt.

QuitNow™ application[20]

Health issues targeted: Tobacco use

Focus areas: Health promotion and disease prevention, Treatment compliance

Technology requirements: Smartphone, Internet

Opportunities:

- Health improvement and reduction of deaths related to NCDs
- Savings due to reduction in organs transplants resulting from tobacco use

Tobacco use is the leading risk factor for most NCDs. Active smoking, second-hand smoking (passive smoking), or smokeless tobacco use, in one way or another, kill 1,500 people every day and account for one-sixth of all NCDs deaths[21]. Tobacco is responsible for at least 16 cancers, including the most acute ones such as cancer of the lung (accounting for one in five cancer death[22]), bladder, kidney, stomach, and cervix[23]. In addition, smoking increases the risk of heart disease and stroke by two to four fold[23]

QuitNow™ is a free, interactive mobile application compatible with Android, iOS, Windows Phone, and Blackberry that supports people in deciding to give up smoking. Its different features include the ability to evaluate one's progress in terms of health, money savings, etc. Moreover, it includes additional features intended to motivate and support the smoker in his/her decision to quit, including points awarded for not smoking and the ability to share one's progress with friends.

4.3 REPUBLIC OF KENYA (EAST AFRICA)

Kenya is a largely rural nation with only 24.8% of its estimated 44.4 million inhabitants living in urban areas (as of 2013)[8]. Its GDP is approximately US \$44.15 billion and agriculture is the dominant sector, employing 75% of the workforce[8]. The real GDP has seen annual growth of about 4.5%[8] and the Nairobi Securities Exchange (NSE) is ranked fifth in Africa in terms of market capitalization[24].

In Kenya, universal care for its citizens has always been a priority for the authorities. This political will has spawned many grand attempts to achieve universal care, but these measures have quickly failed due to the dearth of financial resources and shortage of qualified human resources[25]. In fact, the majority (51%) of trained doctors from Kenya emigrate to elsewhere[25]. As consequence, in 2012, only 43.8% of births were attended by a skilled provider[26]. However, urban-rural disparities persist in this broad statistic. Although 74.8%[26] of births in urban areas are assisted by a skilled provider, rural areas only see 36.8% coverage. Furthermore, only 60% of births are registered and 84 of every 1,000 children born alive die before they are 5 years old[8]. The life expectancy at birth is about 61.7 years[8].

Childcount+[27]

Health issues targeted: Maternal and child health

Focus areas: Data collection and disease surveillance

Technology requirements: Phones

Opportunities:

- Maternal and child health improvement
- On-line tracking of disease/condition evolution for rapid intervention
- Up-to-date and accurate data on childbirth facilitates pro-child policy shaping

Birth registration is a fundamental human right that has significant consequences on the child's future. A birth certificate is necessary to get access to schools and financial services; without one, a person's life is harder and they are left more vulnerable. Only 44% of children under five are registered in the Sub-Saharan region[28]. The first five years after birth determine the child's future survival. Despite the recent reductions in child vulnerability, Sub-Saharan Africa has an under-five mortality rate of 98 per 1,000 live births [29]

ChildCount+ is a mobile-phone-based health (mHealth) platform developed by the Millennium Villages Project and is aimed at empowering communities to improve child survival and maternal health. The program uses text (SMS) messages to facilitate and coordinate the activities of community-based healthcare providers, and also to register patients and their health status on a central Web-based dashboard that provides a real-time view of the health of the community. This is combined with automated alerts that help reduce gaps in treatment. Moreover, ChildCount+ is introducing applications for access to health manuals and to reinforce training across a range of topics, including family planning, reproductive health, care for newborns, and malnutrition. ChildCount+ supports the delivery of community-based management of acute malnutrition programs, home-based testing for malaria using Rapid Diagnostic Test (RDT) kits, and immediate dispersal of treatments.

M-pesa[30]

Health issues targeted: Obstetric fistula (O.F)

Focus areas: Emergency Medical Response

Technology requirements: Phones

Opportunities:

- Maternal health improvement
- Integration of previously marginalized women into the economy and community welfare

Obstetric fistula is a serious health challenge that, left untreated, often forces women into social exclusion. Every year, 50,000–100,000 new cases of fistula are reported, with the main cause being extended labor during childbirth[31]. Surgical intervention is required and the costs are generally covered by governments or philanthropic organizations. Still, many women cannot access treatment because they live too far from a properly equipped surgical center.

Thanks to the M-PESA™ service (*pesa* means *money* in Swahili); Kenyan women can directly receive a subsidy for their transportation costs. This program clearly demonstrates the potential of mobile phones by improving the economic status of women and the health and well-being of their families. A direct transfer of money through M-PESA allows a targeted woman to access funds and to afford bus fares to a nearby hospital for corrective surgery.

4.4 FEDERAL REPUBLIC OF NIGERIA (WEST AFRICA)

Reasonably identified as the *Giant of Africa*, Nigeria impresses with its 173.6 million citizens, fertility rate (six children per woman), and massive economy[8][32]. In 2014, after the rebasing, Nigeria became the largest economy in Africa with a GDP of about US \$509.9 billion[33]. Almost 51% of Nigerians live in cities and, despite the acknowledged mismanagement and corruption in many sectors; the country economy represents a serious promise for growth[8]. However, as in many African countries, Nigeria faces many health challenges: The infant mortality rate is 75.1 deaths per 1,000 live births and the life expectancy at birth is about 52.5 years in 2013[8]. *Brain drain* has only served to weaken the healthcare system, resulting in only 48.7% of births being attended by a skilled provider and only 41.5% of births being registered[32]. In addition to the classic issues, Nigeria also faces the problem of a glut of counterfeit medicines. For instance, in 2011, 64% of anti-malarial medicines imported to Nigeria were reported fake [34].

mPEDIGREE[35]

Health issues targeted: Counterfeit medicines

Focus areas: Medicine and medical equipment delivery

Technology requirements: Mobile phones

Opportunities:

- Cost savings by reduced/avoided hospitalizations
- Reduction in deaths associated with fake medicines
- Pharmaceutical brand enhancement

In order to tackle fake medicines, the Hewlett-Packard Company (HP) created the Global Product Authentication Network as an easy-to-use, secure, and scalable system for authentication and tracking of pharmaceutical products. HP leveraged their expertise and technology to create a cloud infrastructure that makes such authentication fast, easy, and secure. Selected pharmaceuticals contain a code that is printed on the packaging. Individuals can send that code via text or SMS message to the mPedigree system, which quickly returns a message telling them whether or not the medication is authentic. The Global Product Authentication Network is a win for everyone involved.

Mobile Community-Based Surveillance mCBS⁴¹

Health issues targeted: Maternal and child health

Focus areas: Data collection and disease surveillance

Technology requirements: Mobile phones

Opportunities:

- Maternal and child health improvement
- On-line tracking of disease/condition evolution for rapid intervention

The mCBS network is a mobile-phone based service tackling maternal health issues. A community worker simply reports a case and its details via text message and the mCBS automatically redirects the message to the closest health worker for emergency response. Once examined by the health worker, the patient can then be referred to the closest health facility.

4.5 REPUBLIC OF SOUTH AFRICA (SOUTHERN AFRICA)

South Africa has been consistently the largest, most structured, and formal economy in Africa. It is part of the BRICS group of large emerging countries with a GDP of about US \$385.1 billion and an annual real GDP growth of 2.8%[8]. According to the Global Competitiveness index for 2013-2014[36], South Africa is the second most attractive country in Africa and ranks 53rd worldwide. The country has a diverse economy with a striving financial sector, wholesale and retail services, and mining and manufacturing industries. Despite its remarkable economy figures, however, the country faces some social challenges that prevent the majority from sharing in the country's wealth. In 2013, South African had a population of 52.8 million, 62.9% of whom lived in cities[8]. Infant mortality was 38.1 deaths per 1,000 live births but life expectancy at birth was only about 56.9 years. This low life expectancy is explained by the limited access to anti-retroviral medicines for the large HIV/AIDS-positive population in the country[8]. Actually, HIV/AIDS is the most prevalent and severe health issue in South Africa. Adult HIV prevalence in 2012 was at 17.9% and the proportion of pregnant women that were HIV positive was 29.5%[37]. Such a disparity requires immediate action to balance and reduce the spread of this disease.

Cell-life[38]

Health issues targeted: HIV/AIDS

Focus areas: Data collection and disease surveillance; Health promotion and disease prevention

Technology requirements: Mobile phones

Opportunities:

- Cost saving due to early monitoring
- Maternal and children health improvement

In this program, after care health workers monitor patients whom they visit at home. Workers use data-enabled mobile phones to record information about the patient's medical status, medication adherence, and other relevant factors. The data are then transmitted via SMS to the central Cell-Life database, where care managers use a web-based system to access and monitor incoming patient information. Initial program results were encouraging, but significant challenges remain. Cell-Life runs a program for HIV positive mothers. Mothers with newborns will receive a 10 week program of SMS text messages that will encourage mothers to come to their post-natal appointments and continue on their chosen track of breast or formula feeding, and give facts about HIV/AIDS and treatment.

Mobile Alliance Maternal Action (MAMA) [39]

Health issues targeted: Children and maternal health

Focus areas: Health promotion and disease prevention

Technology requirements: Mobile phones

Opportunities:

- Maternal and children health improvement
- General health conscientious awareness among women

MAMA South Africa (SA) uses mobile phones to inform and empower mothers to adopt healthy behaviors and to access maternal and child health services. Currently, the service offers:

- A free SMS program offered through two inner-city clinics in Hillbrow, Johannesburg
- A dynamic community portal or mobisite
- An interactive quiz service readable on any basic phones

MAMA SA will expand to include voice services for mothers with low literacy, and a portal on Mxit - a popular mobile social network.

5 EXPERTS' VIEWPOINT

Emeka Oparah | Director, Corporate Communications & CSR | Airtel, Nigeria

How do you explain the current status and the future of the mobile phones market in Africa?

"Before 2001, Nigeria as well as many other countries in Africa was lagging behind. Telephones were seen as a symbol of pride and differentiated social groups. However, after the first licenses were granted, the uptake was immediate. People noticed the impact the mobile would have on their life. Today, despite the fact that Nigeria is sitting on about 110 million lines, there are still millions of rural dwellers to whom mobiles advancement need to reach out. The perspectives are promising and it is a big deal. Within the next 5 years, the African mobile market will reach maturity but not saturation."

What are the challenges you have been facing in implementing m-health projects and what threats do you foresee?

"Some challenges that could confront an investor in m-health are mainly, general population acceptance, government bureaucracy, and approval for health initiatives especially in terms of the quality of content delivered to the network customers. I recommend being moderately optimistic about timelines when dealing with government officials. Despite these resistances, adoption of m-health possibilities by the different players in Africa is still ongoing."

Jawahar Kanjilal, Jawahar Kanjilal, eMobile and ICT for Development expert, creator of Nokia Life Tools, Singapore

What should be taken into consideration for successful m-health initiatives?

"The happy news about the opportunities mobiles constitutes is that almost everyone is aware of their potential. From the individuals to development organizations the benefits of mobiles are known and, especially, their role in bridging gaps. A participatory approach with the different stakeholders, patient-oriented, and a robust evaluation system are necessary to ensure impactful m-health projects. In addition, the actors should not refrain themselves from exploring new ways. There are many possibilities ahead. We are just getting started!"

What concerns arise in the mobile's age and with cutting edge technologies? How do you conceive their resolution in developing countries?

"The other prominent question that mobile phone usage brings to stakeholders, mainly government and citizens, is data privacy. Unlike the developed countries where there are some laws enacted for this sake, the developing world is still lagging in terms of setting a framework to preserve privacy. Therefore, it is urgent for emerging markets to define principles to safeguard data. If well adopted, mobile use in health would definitely be very exciting and the journey has just started."

6 CONCLUSION

In summary, mobile phones and the associated advanced technologies are bridging the gaps between healthcare services and patients in Africa. Many cases of best practices exist, but they raise some concerns, among which the most prominent is data privacy. How can regulations eventually tackle the individual data privacy issue? How can currently available data, which is available in various format (video, text, audio, etc.), be fully exploited? What partnership framework would fit in these opportunities? Besides the solutions that will be developed by the various stakeholders, what is the most important are open mindedness and a continued search for successful cases. The age of m-health has only just started and is expected to bring unprecedented opportunities in healthcare. These examples could be replicated elsewhere and would help resolve efficiently healthcare problems.

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REFERENCES

- [1] World Bank, "GDP growth (annual %)." [Online]. Available: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?order=wbapi_data_value_2012+wbapi_data_value+wbapi_data_value-last&sort=desc. [Accessed: 14-May-2014].
- [2] KPMG, "Oil and Gas in Africa : Africa's reserves,potential and prospects," Industry report, 2013.
- [3] UNCTAD, "Global Investment Trends Monitor," 15, Jan. 2014.
- [4] TOSIN SULAIMAN, "South Africa was continent's top FDI recipient in 2013," Johannesburg, 28-Jan-2014.
- [5] World Bank, "Doing Business 2013," 2013.
- [6] ITU, "Statistics." [Online]. Available: http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx?utm_source=twitterfeed&utm_medium=twitter. [Accessed: 10-Apr-2014].
- [7] GSMA, "Sub-Saharan Africa Mobile Economy 2013," 2014.
- [8] African Development Bank Group, "Data Portal." [Online]. Available: <http://www.afdb.org/en/knowledge/statistics/data-portal/>. [Accessed: 02-Apr-2014].
- [9] Kambamba Darly, "La santé à l'agonie en République démocratique du Congo," *Contrepoints*, 03-Sep-2012.
- [10] IHME, "Maternal mortality of 180 countries 1980-2008," 2009. [Online]. Available: <http://www.healthmetricsandevaluation.org/publications/summaries/maternal-mortality-181-countries-1980-2008-systematic-analysis-progress-toward-data-methods>. [Accessed: 19-May-2014].
- [11] CMHI, "Heberden Telemedicine System."
- [12] Amazon, *Amazon Prime Air*. 2014.
- [13] John Hall, "Amazon CEO Jeff Bezos says drone deliveries are nearly here," *Mail Online*, 11-Apr-2014. [Online]. Available: <http://www.dailymail.co.uk/news/article-2602419/Delivered-drone-doorstep-Amazon-CEO-Jeff-Bezos-says-courier-future-nearly-here.html>. [Accessed: 26-May-2014].
- [14] Amer Sultan, "UK concerned about 'closure of political space' in Egypt," *Ahramonline*, 15-May-2014.
- [15] CIA, "The World Factbook," 06-Dec-2013. [Online]. Available: <https://www.cia.gov/library/publications/the-world-factbook/fields/2226.html>. [Accessed: 05-Apr-2014].
- [16] WHO, "Noncommunicable Diseases (NCD) Country Profiles," 2008.
- [17] Vinayak Prasad, "NCDs and Mobile Health," WHO, 2011.
- [18] WHO, "Tobacco: a major risk factor for Non-communicable Diseases," 2014.
- [19] WHO, "Global Adult Tobacco Survey (GATS)," Egypt Country Report 2009, 2010.
- [20] Quit Now, "QuitNowapp." [Online]. Available: <http://quitnowapp.com>. [Accessed: 21-May-2014].
- [21] R. Beaglehole, R. Bonita, R. Horton, C. Adams, G. Alleyne, P. Asaria, V. Baugh, H. Bekedam, N. Billo, S. Casswell, M. Cecchini, R. Colagiuri, S. Colagiuri, T. Collins, S. Ebrahim, M. Engelgau, G. Galea, T. Gaziano, R. Geneau, A. Haines, J. Hospedales, P. Jha, A. Keeling, S. Leeder, P. Lincoln, M. McKee, J. Mackay, R. Magnusson, R. Moodie, M. Mwatsama, S. Nishtar, B. Norrving, D. Patterson, P. Piot, J. Ralston, M. Rani, K. S. Reddy, F. Sassi, N. Sheron, D. Stuckler, I. Suh, J. Torode, C. Varghese, and J. Watt, "Priority actions for the non-communicable disease crisis," *The Lancet*, vol. 377, no. 9775, pp. 1438–1447, Apr. 2011.
- [22] J. Ferlay, H.-R. Shin, F. Bray, D. Forman, C. Mathers, and D. M. Parkin, "Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008," *Int. J. Cancer J. Int. Cancer*, vol. 127, no. 12, pp. 2893–2917, Dec. 2010.
- [23] U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, "The Health Consequences of Smoking—50 Years of Progress," 2014.
- [24] Profex, "City Information." [Online]. Available: <http://www.profexhibitions.com/kenyabuildex/cityinfo.html>. [Accessed: 15-Apr-2014].
- [25] CSIS, "Kenya: The Big Picture on Health."
- [26] UNICEF, "Kenya Statistics," 27-Dec-2013. [Online]. Available: http://www.unicef.org/infobycountry/kenya_statistics.html. [Accessed: 15-Apr-2013].
- [27] CMHI, "ChildCount+."
- [28] UNICEF, "Birth registration."
- [29] UNICEF, "Levels & Trends in Child Mortality," 2013.
- [30] UNFPA, "Mobile Phones + Fistula: What's Next?," Jul. 2012.
- [31] H. J. van Beekhuizen, R. Unkels, N. S. Mmuni, and M. Kaiser, "Complications of obstructed labour: pressure necrosis of neonatal scalp and vesicovaginal fistula," *The Lancet*, vol. 368, no. 9542, p. 1210, Sep. 2006.
- [32] UNICEF, "Nigeria Statistics." [Online]. Available: http://www.unicef.org/infobycountry/nigeria_statistics.html. [Accessed: 15-Apr-2014].
- [33] Tolu Ogunlesi, "Nigeria overtakes South Africa to become Africa's largest economy," *theguardian*, 17-Apr-2014.

- [34] The Economist, "Bad medicine," *The Economist*, 13-Oct-2012.
- [35] Mpedigree, "Final Copy of Case Study," 2012.
- [36] WEF, "Global competitiveness report 2013-2014," 2014.
- [37] Avert, "South Africa HIV & AIDS Statistics."
- [38] Cell-life, "Cell-life." [Online]. Available: <http://www.cell-life.org/>. [Accessed: 20-May-2014].
- [39] MAMA, "MAMA," 2014. [Online]. Available: <http://www.mobilemamaalliance.org/mama-south-africa>. [Accessed: 15-May-2014].