Towards a Holistic Approach to digitisation of healthcare delivery in Sub-Saharan Africa and beyond: Setting a new agenda for the digitisation endeavour and direction of foreign aid

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ABSTRACT
The Millennium Development Goals agenda is coming to an end. Sub-Saharan Africa will only partially meet two of the goals. Healthcare delivery in the region has been deteriorating. Scarcity of quality, disaggregated and timely healthcare data exacerbates the problem. The Global Community recognises the opportunity and need for digitisation of healthcare service delivery in SSA and other developing countries influencing the direction of funds and policy. The recent decade was characterised with an explosion of ICT projects aimed at various areas of healthcare. Yet, most of the digital endeavours failed to achieve scalability, sustainability and faced problems in their implementation to bring the desired socio-economic impact through improving decision-making and increasing transparency of public services. Building on research conducted for the purposes of a Master’s Thesis at the London School of Economics and an LSE Research Project in the Gambia, this essay provides an understanding of the antecedents of this failure and proposes a new agenda for digitisation of healthcare delivery in SSA and beyond. The overarching reason for failure of these projects in the Gambia and potentially other developing countries is not the lacking infrastructure, or higher level barriers identified in the academia but the lack of a Holistic Approach to digitisation of healthcare delivery that starts with process mapping and understanding of the obfuscated reality behind the underlying healthcare delivery systems. This new approach calls for foreign aid to support Public-Private Partnerships that through alignment of business interests with social goals will transform millions of lives.
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Introduction

With the existing trends prevailing, Sub-Saharan Africa (SSA) will only partially meet two out of eight health-related MDGs before the Millennium Development Goals agenda ends in 2015 (WHO, 2011) (UN, 2014). Scarcity of quality, disaggregated and timely healthcare data exacerbates the problem preventing evaluation of developmental projects (UN, 2013). One of the overarching themes of the new, post-MDG agenda will be digitisation of healthcare making it the focus of policy and funding in the coming decades. Organisations such as the World Bank, WHO, UN (e.g. UN, 2012) as well as the African Union in the Common Africa Position on the Post-2015 Development Agenda (African Union, 2014) support this view. Ultimately, the Global Community recognises the opportunity and need for digitisation of healthcare service delivery in SSA and other developing countries.

The work by notable scholars such as Amartya Sen points to the fact that informational infrastructure is a critical antecedent of achieving equity of healthcare delivery in developing countries (Alampay, 2006), and thus a critical factor in poverty alleviation. Scholars such as Cecchini and Scott (2003), as well as studies by international organisations including the World Bank (Pigato, 2001) and WHO (WHO, 2005) support this view and argue that Information and Communications Technology (ICT), defined as the “set of activities that facilitates the capturing, storage, processing, transmission and display of information by electronic means” (Cecchini and Scott, 2003, p. 73), leads to better decision making and supports poverty eradication endeavours (Bukachi and Pakenham-Walsh, 2007).

There is a huge yearning for such impactful ICT interventions among the SSA countries. The region suffers from severe constraints against economic growth (World Bank, 2014a). More than 40% of the population is illiterate, poverty ravages with 48.5% of population living below the poverty line (World Bank, 2014b). Communicable and non-communicable diseases prevail (Unwin et al, 2001; Dalal et al, 2011). Researchers, practitioners and international organisations alike argue for the transformative potential that ICT could bring in the areas of healthcare delivery, education, and economic development. The positive socio-economic impact of data-driven decision making, facilitated by effective health information systems is clear (e.g. Ngwenyama et al, 2006; Alampay, 2006; Jennett et al, 2003; Bankole et al, 2011b) with benefits ranging from cost-effectiveness, access, transparency, reduced inefficiencies on the healthcare delivery system, positive health outcomes to better quality of life.

While a World Economic Forum report on ICT shows that overall ICT readiness in SSA is still low (Dutta and Bilbao-Osorio, 2012), the recent decade was characterised with what can only be called an explosion of ICT projects aimed at various areas of healthcare (Wamala and Augustine, 2013) with significant investments in ICT infrastructure (Bankole et al, 2011b). Such projects often benefit from substantial resources coming in form of development assistance.

Yet, the healthcare situation in SSA has been deteriorating. The efficacy of health information systems and digital applications in developing countries and SSA in particular is disappointing.

(Wamala and Augustine, 2013). Most of the digital endeavours failed to achieve scalability, sustainability and faced problems in their implementation to bring the socio-economic impact through improving decision-making and increasing transparency of public services (Averou, 2008; Olajide for the WHO, 2011). Bonair et al (1989) state that unravelling the reasons behind failures to utilise effectively implemented technologies is one of the most salient concerns about applying technological solutions to the developing world.

As part of a Master’s Thesis at the London School of Economics the author investigated the existing state of knowledge about digitisation of healthcare and the current approaches to implementing ICT within governmental functions. The Thesis built on an LSE Research Project lead by the author in the Gambia in collaboration with an NGO - Riders for Health. During fieldwork in the country, through a large number of interviews, focus groups and observations as well as help from two students from the University of the Gambia, the project team managed to develop an understanding and a gap analysis of the current state of healthcare data collection and dissemination in the country to provide the NGO with a number of actionable recommendations. The more overarching issue that emerged and the key proposition of the Thesis and the topic of this essay – the Holistic Approach – embedded within existing frameworks derived from the literature lead to development of the Holistic ICT Ecosystem that provides a new, eclectic framework for the digitisation effort.

The framework was put in perspective of numerous discussions with practitioners and experts including a brainstorming session and follow up communication with the Vice Chancellor of the University of the Gambia – direct advisor on IT matters to the President of the Gambia.

It shows that the overarching reason for failure of digitisation projects in the Gambia and potentially other SSA countries is not the lacking infrastructure, or some higher level barriers as suggested by the academia but the lack of a systemic approach to digitisation of healthcare delivery. Such an approach starts with process mapping and understanding of the inherent complexity of the underlying healthcare delivery systems. This essay provides an overview of this analysis and puts forward a new agenda for the digitisation effort in the coming decades that revolves around the propositions of the Holistic Approach.

The academia on digital endeavours

ICT for healthcare service delivery has been explored to a large extent in the context of developed countries. The academic literature on ICT in developing countries and especially the idiosyncratic environment of the SSA region is underdeveloped in comparison (Meso, 2008) despite the recognised potential for ICT to transform the region’s healthcare and contribute to its socio-economic development (Ngwenyama et al, 2006; Mars, 2013). Averou (2008) in a recent review of literature on ICT in developing countries identifies the prevalent discourses in academic journals that

1 See Appendix I for details of the LSE Research Project, Master’s Thesis and the relevant actors.
2 See Appendix II for details of the data gathered for the purposes of conceptualising the ideas put forward in this essay.
venture into the context of least developed economies. Unfortunately none of them pertains to the critically needed, actionable frameworks for digitisation. There is a lack of new approaches that could transform foreign aid into sustainable and scalable digitisation endeavours that would bring the desired impact (Avegrou, 2008; Hirschheim et al, 1996).

Review of Information Science Journals such as the MISQ, JAIS, EJISDC, JGIM, JGITM proved useful in developing an initial understanding. However, conceptualising a comprehensive framework for digitisation of healthcare in SSA required a robust conceptual model as a starting point. Such a framework was developed by Mbarika et al (2005). The framework is a manifestation of the state-of-the-art literature on the topic. It calls for transforming ICT infrastructure into tangible and intangible resources that lead to socio-economic impact. ICT infrastructure investments are seen as the critical antecedent of success of digitisation endeavours in SSA and their scarcity as the overarching barrier (Odedra, 1993; Mbarika et al 2005; Meso, 2008).

Academics and international organisations show that resolving the dire healthcare situation in SSA is the most critical challenge to bringing the region out of poverty and allowing it to embark on a path

3 See Appendix III - ICT and resources for full explanation

4 Fraser et al (2005) and Cecchini and Scott (2003) elucidate that of paramount importance is utilisation of ICT applications for improving healthcare data flows. Stansfield (2005) and Mutemwa (2005) argue that effective information systems empower decision makers to better utilise and allocate scarce resources. Walsham and Sahay (2006) emphasise the role of data in ensuring quality and responsiveness of healthcare delivery. Therefore, while the potential applications of ICT for improving healthcare delivery systems in SSA are numerous, there exists a consensus in academia that improving healthcare data systems is the critical step in the overall push towards digitisation. Transparency and effectiveness of healthcare data flows is essential. Not only does it drive frugal decision making, salient in a low-resource, developing-country setting, but also provides the ability to monitor and evaluate the digitisation endeavours aimed at all other areas of healthcare delivery.
towards sustainable development. ICT is then seen as the “great equalizer” (Drucker, 2001; Gebremichael and Jackson, 2006) that can support data-driven decision making to guide efficient and effective delivery of healthcare services both to urban and rural areas in SSA (Kifle et al., 2006; Wootton, 2001) where resources and medical personnel are scarce (Rowe et al., 2005). Ultimately, the author refined the initial ecosystem in Mbarika et al. (2005) to reflect the focus on healthcare and digitisation of data flows in particular.

The resulting framework, however, does not incorporate the barriers to realising the socio-economic benefits of digitisation in the context of SSA. Barriers identified through a thorough literature review were put into context of the Mbarika et al.’s (2005) Ecosystem to create the Extended ICT Ecosystem (figure below).

Extended ICT Ecosystem (adapted from Mbarika et al., 2005, p. 137)

The framework, as outcome of the literature review, shows that the digitisation agenda must start with establishing an appropriate ICT infrastructure – the overarching, underlying barrier through appropriate investments and overcoming any associated bottlenecks. Then, through simultaneous
deployment of tangible, intangible and personnel-based (human capital) resources, the ICT infrastructure can be successfully adopted and developed to create infrastructure capabilities for the purposes of deploying sustainable and scalable digital healthcare interventions that bring the desired benefits of improved healthcare delivery.

The barriers\(^5\) in the model inhibit the process of adopting and recombining the infrastructure into resources and capabilities. They substantiate the framework to provide a complete theoretical tool for analysis and digital application development. Ultimately, interventions that take an approach to digitisation of healthcare delivery services and data flows in particular that follows the propositions of this Extended ICT Ecosystem and that addresses these barriers should be successfully implemented and achieve sustainability and scalability. The essay will reveal that there exists a more underlying barrier that can undermine this success and explanatory power of the framework.

**The Extended ICT Ecosystem as an insufficient explanation**

The Extended ICT Ecosystem – a manifestation of the current state of literature on the antecedents of failure and success – was utilised to analyse a wide range of digital interventions with a focus on the case of the Gambia.

The propositions derived from the literature did not provide sufficient explanation for the failure of the investigated endeavours. In fact, many of the propositions are shallow and failed to grasp the underlying problems that manifest themselves in these barriers. A typical barrier, lack of funding was not related to scarcity of resources or unwillingness of the decision-makers to direct them towards the digitisation endeavour. Rather, the salience of the particular projects was never made clear to the higher officials. They were not perceived as an integral part of the healthcare delivery system that the particular digitisation applications were designed to improve.

For example, SMSforHealth, a widely appreciated by MoH officials, SMS based solution failed due to this sole fact. It was aimed at digitising a critical aspect of healthcare service delivery in the Gambia – planning and distribution of medicines. Despite satisfying practically all propositions of the Extended ICT Ecosystem, it failed to recognise that this planning and distribution is a manifestation of effort by the whole delivery system from the very bottom where distribution occurs, through regional health centres where the stockpiles are stored all the way to decision-making bodies who engage in supply chain and procurement planning. Developing such systemic understanding is not a pre-requisite in the Extended ICT Ecosystem, nor is it integrated into existing approaches to digitisation.

Indeed, as noted by a Regional Public Health Nurse who oversees the distribution of drugs at the regional level:

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\(^5\) The scope of the essay does not allow for a full discussion of these barriers. An account of the literature review that unravelled them is provided in Appendix II – Barriers in the Extended ICT Ecosystem.
“There was no feedback from the higher level. It was a one way communication.”

This suggests that the officials at higher levels of the Ministry were not participating in the project. One of the interviews with the Chief Pharmacist was revelatory in this context:

“The key stakeholders could have utilised the data more. On a day-to-day activities, in terms of procurement and so on.”

“They key gap or what could have been done is that the project should have undergone some management. All the data should have been analysed, with some key stakeholders. (Only then) can the solution be developed and data disseminated”

The Extended ICT Ecosystem would suggest that such problems are a manifestation of, for example, inappropriate design of the solution or lack of human capital. In fact, it was the approach to digitisation that was misconceived. It neglected the underlying interactions among the actors within the complex, obfuscated reality of the healthcare delivery system. In fact, this underlying barrier was reappearing throughout the process of the analysis and prompted the author to re-engage with the data in seek of explanations for failure and potential antecedents of success of this and other projects. The next part provides the outcomes of this analysis and categorises existing approaches to digitisation with their respective shortcomings.
The practitioners on digital endeavours - existing, limited approaches to digitisation

In the inductive part of the analysis, the case study evidence was reviewed in seek of explanations for failure of digitisation endeavours that go beyond the propositions derived in the Extended ICT Ecosystem. These were put in perspective of the types of approaches that these endeavours take and the three overarching types of failure identified in the literature – sustainability, scalability and implementation – to develop a Thematic Network of healthcare service delivery interventions.

The Network (see figure on next page) encapsulates three key existing approaches to digitization of healthcare delivery services in SSA and the associated types of failure following a review by Avgerou (2008):

- Solution Approach (1) – focuses on development of a digital solution, often in the Western World that is then implemented in SSA to carry some expected socio-economic benefits. These projects tend to fail as their implementation is impaired by not reflecting the underlying context of SSA and they do not bring the outcomes expected by the original developers. Development is inherently removed from context and does not fully recognise the various data collection, aggregation and dissemination points as well as healthcare delivery processes that pertain to them.

A prime example of the fallacy of this approach is the DHIS2 Open Source healthcare database system that is supposed to serve as the focal point in data collection and decision making in the Gambia (see figure in Appendix II). While the reports on DHIS2 suggest that the system is in “Complete national implementation” in the country (DHIS2.org, 2014), in fact, the fieldwork unravelled that the system does not encompass all the relevant actors and institutional relationships in the country and is practically not utilised by decision makers. For example, an excerpt from an interview with the Chief Pharmacist, supposedly a key stakeholder reveals the problem:

“I know that it is web-based, and that’s about it”
“It’s there and apparently when you log in you can get it, but that’s it”
“There’s something not quite right with that”

Thematic Network of existing approaches to digitisation
- Data Flows Approach (2) – focuses on one particular stream of data flows. For example, related to collecting, storing and disseminating information regarding HIV/AIDS prevalence. These applications fail as they are not sustainable and are frequently abandoned after an initial pilot phase. The approach does not embed the particular problem with data flows as part of a larger systemic issue that can only be unravelled when a complete understanding of the entire healthcare delivery service exists.

- Narrow Healthcare Delivery Approach (3) – focuses on institutional actors in one particular stream of healthcare service delivery. This approach, through digital applications, addresses the needs and problems of a limited number of actors in the healthcare delivery service. These applications fail as they are not scalable – they cannot be reapplied to other parts of the healthcare delivery service. The approach does attempt to unravel the underlying complexity, but does so only in a limited scope so that the solution implemented cannot be applied to the whole system and benefit from interactions among the various actors.

*The three existing approaches to digitisation*

While all three approaches may fail due to some idiosyncratic conditions as delineated by the Extended ICT Ecosystem, they all share the common flaw of not reflecting the underlying complexity of healthcare delivery systems in SSA – lack of Holistic Approach.

As the healthcare delivery systems have been growing organically since the Alma Ata Declaration (WHO, 1978) (Gillam, 2008), there is in fact little understanding of the relationships between the different actors and stages of the healthcare delivery system because the data collection, storage and dissemination processes were growing and defining themselves in often haphazard, unstructured and unreported manner.

Ultimately, whatever the barriers identified in the academia or by the practitioners might be and however successful a particular solution might be in addressing them, such approaches will never be
fully successful unless they address the overarching bottleneck argued for in this essay. Removing these obstacles will be critical to embark on a path towards successful digitisation of healthcare delivery services in SSA. However, without reflecting the underlying complexity of healthcare delivery services, the puzzle that persists, applications deployed to address these other significant barriers are likely to fail.

The answer – Holistic Approach

An approach that puts aside development of the digital solution and puts aside the considerations of particular data or service delivery problems and instead begins with developing a thorough understanding of this underlying complexity will address this overarching bottleneck. As put by the Vice Chancellor⁶:

“A substantive approach... it integrates all the functionalities of the health infrastructure. To do this you have to go to the fundamentals... the basic. Zero. We assume that not everything is done right, but we are not discarding it. What is the delivery and data ecosystem in the Gambia in health?”

“Forget digitizing. Sorry. Forget digitizing. If you don’t understand the current workflow, the current data flow, the current process mapping of the health ecosystem here... what are you digitizing?”

“This is why you have 60, 70, 80 prototypes that fail! It’s not looked at from a systemic view and approach... this is a humongous task.”

Analysis of the evidence, discussions with practitioners and experts and in particular the brainstorming session that the author facilitated at the University of the Gambia lead to conceptualization of the Holistic Approach. This approach aims to provide an agenda for tackling this “humongous task”, embedding it within the larger Extended ICT Ecosystem and bringing the desired socio-economic outcomes of healthcare digitization in SSA.

Academic studies that attempt to explain the failure and antecedents of success of digital healthcare interventions in SSA start at later stages of the digitisation framework. For example, an extensive review by Omary et al (2009) provides an understanding of a range of barriers to digitisation. However, the authors begin their analysis with barriers to adoption of digital healthcare applications, specifically “Challenges to e-healthcare adoption” (Omary et al, 2009, p. 204).

The Holistic Approach calls for refocusing the digitisation effort towards developing an understanding of the underlying healthcare delivery systems. The logic of the approach is presented in figures on pages 16 and 17. The logic is rooted in the two persistent problems in healthcare delivery systems in SSA. First, the existing healthcare data is obfuscated and unclear. Second, there is current data that continues to flow in often unstructured, haphazard manner. Both are a

⁶ See Appendix I – Key Actors – University of the Gambia
manifestation of the complexity of the underlying healthcare delivery systems. As put during the Brainstorming Session at the University of the Gambia:

“You will never be able to digitise if you don’t tame this. You see... You have to approach it from a systemic approach.”

“Before you actually get into the digitising phase, there is a lot of current infrastructure mapping that you have to do. Once you have all of that, now you can begin to build the ICT infrastructure and data architecture. Then do your correct data modelling. But that data architecture will now take into account all of these [interactions] that you have captured, that have data elements. Now you have to design a very clean, uniform way of capturing data that will relate to the old data infrastructure that existed. It’s a lot of work to do it right. What tends to happen is people will just come, just carve out an area and create a prototype for it.”

Following the logic of the Holistic Approach should ensure that all these relevant actors, processes and data points are included in the digitisation endeavour that follows the premises of the Extended ICT Ecosystem. In other words, these will be included in appropriate ICT infrastructure investments, translation of these investments into tangible and intangible assets that, with appropriate human capital, can be deployed for implementing successful, sustainable and scalable digital healthcare applications.

“It is a lot of opportunities. You can wake up every single day just to process this, just to do the process of mapping of the current.”
Logic of the Holistic Approach

- Investigate the current interactions among all the actors within the Healthcare delivery system – disentangle all the institutional processes at the macro and micro level encompassing the public and private sector
- Understanding of the processes and interactions will allow to understand the data points and flows
- Map the healthcare delivery service as is

- Analyse data that is already stored and has been accumulating – existing processes of capturing data are not clear and there is no holistic picture of what is being captured
- Analyse the data that is continuously produced – the constant flow of data has to be tamed systematically, not haphazardly targetting only one stream of the flow
- Map the data flow to identify connections between the datapoints

- Only once the institutional processes at the macro and micro level are disentangled with a systemic approach, building the data architecture can commence
- Analyse the gaps in the incumbent system as they appear from the mapping processes from the previous stages
- Develop data architecture and modelling tools that encompass all the understanding to design a clear and uniform way of capturing data that will relate to and resonate with the old data infrastructure that existed
- Follow propositions of the Extended ICT Ecosystem

**Holistic ICT Ecosystem**

**Underlying barriers**
- Covert reality of healthcare delivery systems
- Lack of expertise/resources for holistic approach
- Lack of business case for holistic approach

**Holistic Approach**

**Healthcare Service Delivery Map**

**Healthcare Data Flows Map**

**Barriers: technological infrastructure**
- Teledensity/Wireless Infrastructure
- Internet/PC Access
- Haphazard ICT investments

**ICT Infrastructure Investments**

**Economic Outcomes**

**National ICT Infrastructure Development**

**Social Outcomes**

**Personnel-based resources**

**Tangible resources**

**Intangible resources**

**Socio-economic ICT Infrastructure Applications**

**Data**

**Healthcare**

**Decision making**
Challenges of the Holistic Approach

The Holistic Approach brings additional challenges to digitisation of SSA. If we accept that without such a thorough, systemic understanding, the digitisation endeavour will be undermined, the agenda for digitisation must include it in its basic premises. However, unravelling the underlying complexity of healthcare delivery systems and mapping them in a systematic way requires significant resources and expertise SSA countries are consistently found to be lacking. Such projects might take many years to complete and the direct economic and social benefits cannot be easily quantified. The key barriers to employing the approach include what follows.

Covert reality of healthcare delivery systems

While the Holistic Approach carries the opportunity to refocus the effort of scholars and practitioners to overcoming this barrier, in itself it poses a significant challenge. Governmental functions that support healthcare delivery in SSA are often unstable with high staff rotation even in the higher positions. Access to relevant actors within governmental and service delivery structures is restricted, especially to foreign practitioners. Sociological and cultural differences pose a challenge to conducting the mapping processes. Ultimately, access to the healthcare delivery service is often restricted to actors who do not have the capability or inclination to engage in untangling its underlying complexity.

Lack of expertise/resources for Holistic Approach

SSA countries tend to suffer from poor governmental capacity and overall human capital to engage in the digitisation endeavour as elucidated in this essay. A project that develops a complete map of the healthcare delivery service requires significant resources both in terms of expertise as well as funding.

As put by the Chief Pharmacist of the Gambia’s MoH:

“You need someone else to process it, package it and then give it to us (decision-makers) so we can make sense of it (the data), but we didn’t have that.”

A similar opinion was voiced by the Permanent Secretary at the MoH. Foreign expertise in process mapping is essential to lay the foundation for subsequent digitisation as the logic of the holistic approach calls for. This, however, is related to the final and potentially most important obstacle to implementation of the holistic approach.

Lack of business case for Holistic Approach

Mapping of the healthcare delivery and data processes in SSA is a formidable challenge. It requires significant resources and commitment of human capital. The return on this investment is unlikely to realise over the short-term. The problems of management myopia and short-termist, shareholder-value driven outlook of multinational enterprises may prevent large IT organisations from engaging in the endeavour. It can be argued that this is one of the reasons for the early criticism of multinationals by Odedra (1993) who claims that such companies tend to dump technology on SSA
countries to realise profits without the subsequent support that such technology requires to bring the socio-economic benefits. At the same time, these are the organisations that have the capability to engage in successful projects that would push the Holistic agenda forward.

Without commitment and collaboration of technology sector MNEs, manufacturers, distributors and consultants of IT systems, the Holistic Approach will be difficult to realise.

A new agenda for digitisation of healthcare delivery

While the aforementioned constraints might seem discouraging, certain factors point to the fact that there is potential for the Holistic agenda to realise and, according to the Holistic ICT Ecosystem, bring the desired socio-economic impact of ICT.

The first two obstacles, of the complex reality and poor access to the structures of the healthcare delivery systems in SSA as well as scarcity of resources can be resolved through developing Public-Private Partnerships that leverage distinct capabilities of various players to develop synergies that can tackle these issues. Specifically, for the Holistic agenda to be successful the partnership must bring the following capabilities and resources:

1. Expertise in process mapping of governmental, healthcare delivery processes, data flows and developing appropriate, eclectic data architectures.
2. Local human capital that will take part in untangling the underlying complexity and will contribute and eventually take over the management of data architectures built upon this understanding.
3. Ability to bridge the Western capability and resources with the local, developing country context.
4. Ability to influence and shape policy and strategic, governmental decisions to support the Holistic agenda in the long-term.

Using the example of the Gambia and the LSE Research Project, such a Public-Private Partnership could comprise of:

1. A multinational enterprise that has the capability, knowledge and expertise in healthcare delivery, data and process mapping. For example, IBM.
2. A locally operating NGO that works closely with the healthcare delivery service in the country that has developed ties on the ground. For example, Riders for Health who enjoy widespread recognition and support within the structures of the MoH in the Gambia and who have the critical understanding of the healthcare delivery system in the country.
3. Local academic institutions that recognise the potential of digitisation and engage in local capability building in relevant fields such as IT, public health, etc. For example, the University of the Gambia, with their recently established Science, Technology & Innovation Park is strongly supporting the digitisation agenda. Its leaders are willing to collaborate with NGOs and
international institutions alike and engrain themselves in the process of developing and maintaining a data culture in the country.

4. Relevant decision-makers in the MoH and the Government who support the digitisation agenda and are receptive to the opportunities it carries. In many SSA countries digitisation is being increasingly engrained in strategy and “vision” of the leaders as suggested by various strategic, governmental documents. For example, in the Gambia, the Ministry has been infused with young, progressive, educated individuals who recognise this opportunity.

Such a partnership would have the required capabilities and resources to first untangle the obfuscated reality of healthcare delivery systems and healthcare data flows and then follow with the other premises of the Holistic ICT Ecosystem to build a data culture and applications that would fully address the huge yearning for digitization of healthcare in SSA.

While the partnership could overcome the first two barriers to Holistic Approach, aligning the interests of profit-driven MNEs poses the last challenge. The digitisation agenda is becoming increasingly engrained both in local policy and the strategic direction of international organisations. It can be argued that digitisation of healthcare in SSA is inevitable. If we accept that this obfuscated reality and lack of Holistic Approach are the overarching bottlenecks to deploying successful digital solutions in the region, then the organisation that will successfully facilitate and become part of the partnership will be at the forefront of the digitisation agenda that will unfold over the coming decades. Ultimately, a partnership that successfully completes the proposed actions of the Holistic Approach, that develops the understanding, the maps of current healthcare delivery and data processes in SSA and follows the premises of the Holistic ICT Ecosystem will hold the key to further digitisation. Such expertise can be considered, in the resource-based view nomenclature (Grant, 1991), a unique resource and a source of sustainable competitive advantage. The first to start conducting these projects should gain an unsurpassable advantage over competitors. Showcasing this expertise in one country should induce governments of other countries to seek support of the partnership in digitising their healthcare delivery systems. As put by the Vice Chancellor:

“In the realm of such an MNE, they can put a digital application to digitise the entire health ecosystem of the Gambia. And it will not take them much, but what it gives them, is they will show other African countries the way to go for better health delivery...”

Showcasing success of the Holistic ICT Ecosystem in the Gambia, by building on the discussed Public-Private Partnerships to develop an understanding of the underlying healthcare delivery system and then implementing a successful digital ecosystem, is possible within a relatively short time frame. While the business case for such a project in the Gambia might be small due to the size of the country (what creates the opportunity to conduct the project in this limited time frame), achieving this success would open the doors for the aforementioned partnership to engage in digitisation of the whole sub-continent and beyond.

Clearly, the economic benefit to such an endeavour would be significant.
Conclusion
Ultimately, for the tremendous social impact of digitisation of healthcare to be realised, this essay advocates for the international community including the aid agenda to support Public-Private Partnerships that through collaboration and building on synergies of capabilities can develop an understanding of the underlying reality of healthcare delivery systems in developing countries. The argument in this essay does not undermine the current approaches that tend to focus on specific parts or problems in the healthcare delivery systems. Overcoming the significant barriers to digitisation laid out in the academia through ICT projects that build on appropriate infrastructure is critical. However, for the socio-economic benefits of digitisation to be realised in the long-term, the systemic, Holistic Approach must be taken.

The Holistic ICT Ecosystem, that establishes the Holistic Approach within the current literature on the digitisation endeavour, shows that the overarching bottleneck to digitisation is the obfuscated reality of healthcare delivery systems in developing countries. The author believes that there exists an exciting opportunity to facilitate powerful partnerships that can overcome this bottleneck and untangle the persistent puzzle. The International community recognises the need to support the digitisation endeavour in the post-MDG reality. This will increasingly be reflected in strategy of the developing countries and adequate allocation of scarce resources, especially when foreign aid becomes directed towards the agenda. This in turn will create a fertile ground for IT sector MNEs and a sound business case for the digitisation agenda in the developing world. Supported with appropriate financing to follow the premises of this new framework these partnerships will hold the key to successful and complete digitisation of healthcare delivery in SSA and beyond. As decision-making and policy starts benefitting from complete digital data architectures developed in this systemic manner and digital applications built around them that now reflect the underlying reality of healthcare delivery systems, digitisation will bring its anticipated impact transforming millions of lives.

Appendices

Appendix I – the London School of Economics Research Project and Master’s Thesis
The author of this study has been the leader for a London School of Economics research project carried out as part of the assessment for the Business Model Development at the Base of the Pyramid module. The project was carried out in collaboration with an NGO Riders for Health who operate in the Gambia and provide transportation solutions to the Ministry of Health in the country. The project aimed at analysing the current data flows within the Ministry of Health to devise a set of recommendations that would allow the NGO to add more value to the Ministry through digitisation of the healthcare data processes where applicable. The other client – IBM, was interested in exploring the opportunities for engaging in digitisation of healthcare in developing countries and SSA in particular.
The team comprised of five LSE students, three of which went to carry out fieldwork in the Gambia. Through an iterative process, a large number of interviews, focus groups and brainstorming sessions as well as help from two students from the University of the Gambia, the team managed to develop an understanding of the current state of healthcare data collection and dissemination in the Gambia and devised a number of recommendations for Riders for Health. The team conducted a gap analysis of the current healthcare delivery service in the country pertaining to the operations of the NGO. Combined with extensive research on healthcare digitisation endeavours in SSA the team developed a set of recommendations for the actors involved.

The project was a success and the short-term recommendations were implemented by the organisation. These were primarily related to digitisation of operational data collection for the benefit of the NGO itself with a potential to expand these services to training of healthcare workers to use SMS-based solutions for healthcare data reporting in the future.

While these practical implications and benefits of the devised solution were widely recognised and accepted by the NGO, the more overarching issue that started emerging during the project was beyond its scope. This overarching issue is related to the ultimate bottleneck that exists in healthcare data digitisation in the developing world and SSA in particular. Namely, as unravelled in this study, the lack of a Holistic Approach that entails untangling the complexity of the healthcare delivery systems as the first step in the digitisation agenda..

This section of the Appendix will describe the key actors involved in the project and introduce the Gambia as a country where dire situation in healthcare delivery service, typical of SSA, coincides with significant potential for deployment of digital applications for socio-economic development.

Key Actors

The Gambia

Andrea Coleman (CEO, Riders for Health):

“Gambia is a very small country, but very typical of the whole continent of Africa”

Barry Coleman (CEO, Riders for Health):

“People die from easily preventable diseases. If you’re a child, your chances of dying before you’re five are about one in eight. It’s disgraceful. It’s something of which we all should be ashamed.”

Indeed, both the state of the healthcare delivery system and the potential for digitisation of public services in the Gambia are similar to other countries in the Sub-Saharan region.

The country suffers from inequitable and inefficient healthcare delivery service. Compared to global averages, life expectancy is 12 years shorter and infant mortality is twice as high. Prevalence of
communicable diseases such as tuberculosis and HIV is also double that observed globally. Malaria takes particular toll over one quarter of population contracting the disease compared with 4% for the global average (data from WHO report, 2014). Some of these trends are in fact deteriorating both in the country and across SSA. The WHO World Malaria Report (2013) calls for improving healthcare data availability for assessing trends and tackling not only incidence of Malaria but also other diseases. Ultimately, as elucidated in the first section of this study, digitisation of healthcare delivery service emerges as a significant opportunity to improve its impact and allow the SSA countries to embark on a path towards effective healthcare delivery given their low-resource context.

Gambia can also be considered somewhat representative in terms of the potential for this digitisation to occur and be successful despite the prevailing notions in literature that emphasise the poor state of ICT infrastructure as the key bottleneck to digitisation. The recent developments of the last decade have put Gambia’s mobile penetration at levels comparable to those in Europe (Deloitte, 2012), namely 120%.

An International Telecommunication Union report shows that in year 2012, 83.6 out of a 100 Gambians subscribed to mobile services. Furthermore, 3G mobile broadband gained significant popularity with access costs dropping to levels that allow for uniform adoption (BuddeComm, 2014). The author of this study also directly observed this during fieldwork for the purposes of the LSE Research Project. Investigation for the purposes of the Project revealed that the country enjoys almost 100% coverage provided by four mobile network providers – Gamcell, Q-Cell, Comium and Africell. The improvements in teledensity occurred along significant improvements in ICT infrastructure in the country that supports this mobile ubiquity. Ultimately, the teledensity, claimed by many scholars to be one of the overarching bottlenecks to digitisation in the region, ceased to be a valid explanation for the failure of digital endeavours as discussed in this essay.

**Riders for Health**

Riders for Health (RfH) is a UK-based organisation that first came to the Gambia in 1989 to address the persistent problems of the healthcare delivery service in the country. The organisation provides transportation services for the Ministry of Health in the Gambia and 6 other SSA countries to empower the health workers to reach the most remote areas. Therefore, the NGO allows the Ministries to deliver healthcare services in an equitable manner while controlling the costs and utilising the scarce resources in the most effective and efficient way.

The organisation has been delivering excellent results and transforming lives of millions of people in SSA. It enjoys widespread support from the government what allowed the LSE Project Team and the author to engage with all the relevant actors and develop a thorough understanding of the healthcare situation in SSA. This was critical to success of the LSE Research Project and prompted the overarching outcomes of this study.
From the perspective of this essay’s propositions and the Holistic Approach, NGOs like RfH are seen as a bridge between the developed and the developing world and a focal point where the healthcare digitisation agenda converges towards sustainability and socio-economic impact.

**IBM**

In the context of this study, IBM is considered a representative leading global technology company that recognises the opportunity in Sub-Saharan Africa. Being present in the sub-continent for many years, the company has been exploring ideas and business opportunities that would bring the socio-economic impact yearned for. The Holistic Approach puts organisations like IBM as a critical actor in the digitisation agenda in the decades to come.

**University of the Gambia**

Building on a network of connections, the author of this study facilitated a brainstorming session at the University of the Gambia as the Team was commencing fieldwork in the country. In particular, the author engaged with the current Vice Chancellor of the University who serves as the Vice Chairman of the National Committee on Science, Technology & Innovation appointed by the President of The Gambia. The Vice Chancellor provided expertise and advice in conceptualisation of the propositions in this study.

The University of the Gambia has recently established the Science, Technology & Innovation Park in Farabanta, where it is graduating students in the fields of public health and ICT. Therefore, the University recognises the tremendous opportunity in pushing forward development in the country through building up human capital and capability in Information Technology (The University of the Gambia, 2012). Again, local human capital is one of the critical factors of success for the Holistic Approach – the ultimate proposition of this essay – to materialise.
Appendix II – Data

Evidence gathered during the LSE Research Project included focus groups, informal and semi-structured interviews, communication with clients, consultation with practitioners and experts, and archival data such as governmental documentation, internal documents, websites, news articles, press releases and statements by international organisations.

The data corpus utilised in development of the Holistic Approach comprised of a vast range of sources. The author had the opportunity to directly engage in primary data collection process for the LSE project in the Gambia as described in Appendix 1. Additional evidence and data have been brought from additional sources including case studies of healthcare data interventions in SSA and other sources to ensure robustness of the analytical approach and drawn conclusions.

The data corpus has been revisited by the author a large number of times in an iterative process as called for by practitioners in the field of qualitative research (Guest et al, 2011). The author re-analysed the field notes, interviews and other documentation gathered for the LSE project to construct a data set that provides sufficient depth in terms of the two healthcare interventions – the DHIS2 and SMSforHealth analysed for the purposes of the study as well as additional perceptions and insights that helped form the premises of the Holistic Approach. The additional case studies were primarily brought in from a comprehensive report (Vital Wave Consulting, 2009) conducted by Vital Wave Consulting for the United Nations that identifies a vast range of digitisation endeavours. Additional cases -especially those showing different approaches to digitisation) where then brought in from grey literature and case study reports collated through online search. Follow-up checks on those projects, through an investigation of online sources, allowed for developing an understanding of their success and failure and the idiosyncratic factors in which these were conducted.
The key sources derived from the LSE Research Project included:

- 48 interview recordings with individuals at different levels of the Gambia’s healthcare delivery service that pertained to the projects analysed for the purposes of the study coming to a total of twenty two hours of interviews. The interviewees ranged from outreach health workers to the Permanent Secretary at the Ministry of Health. Figure on page 30 shows the part of the healthcare delivery service that the author of this study engaged with in the Gambia.
- 300 pages of interview notes, personal field notes and observations made by the author throughout the LSE Research Project.
- Recordings of 2 focus groups with the Health Management Information Systems unit at the University of the Gambia.
- A 37 pages Gap Analysis of the Gambia’s healthcare delivery service developed for the purposes of the Project and the associated notes.
- Governmental and other documentation obtained from the Ministry of Health, Riders for Health and the University of the Gambia.

Further, of paramount importance were the recordings of the brainstorming session at the University of the Gambia. The brainstorming session was lead by the Vice Chancellor of the University of the Gambia, who is also a direct advisor on IT matters to the President of the Gambia. The Vice Chancellor has decades of experience working and educating about ICT for development across the world and is personally engaged in a range of projects that leverage ICT for development across the world.

Moreover, the findings of this study are substantiated with an analysis of recordings and notes from a London School of Economics panel on mHealth that the author of this study attended on the 14th of March, 2014. The panel has been highly revelatory in terms of the contemporary and future digitisation agenda in the developing world.

Finally, the follow up meetings, e-mails and other communication, facilitated by the author after the LSE Research Project concluded, with practitioners and experts allowed for establishing and refining the ideas pertaining to the outcome of the study – the Holistic Approach.
Data flows and primary data sources in the Gambia

- Village Health Workers
- Traditional Birth Attendants
- Outreach Work by Community Health Nurses and Outreach Clinics

Data Collection

- Major Health Centre
- Public Health Officer
- Community Health Nurse
- Minor Health Centre

Data Aggregation/Dissemination

- Regional Health Directorate

Data Utilisation

- Health Management Information Systems (HMIS) Unit
- Decision Makers

Directorate of Planning and Information

- NBTS/NHLS/NPS/Traditional Medicine
- Directorate of Basic Health
- Directorate of Social Welfare

Board of Health

Administration

- Permanent Secretary
- Deputy Permanent Secretary
- Assistant Secretary
- Registry
- Director of Health
- Chief Pharmacist
- Chief Nursing Officer
- Chief PHO
- Others
Appendix II – barriers in the Extended ICT Ecosystem

ICT and resources
Following Grant’s (1991) classification of resources, Mbarika et al (2005) describe them in terms of their tangible and intangible nature in the SSA context. Where the tangible resources relate to the physical ICT infrastructure and are thought to be the key bottleneck in SSA’s digitisation endeavour, the intangible ones relate to the supporting processes, synergies and structures of governance that allow for ICT deployment. These resources, when coupled with appropriate human capital utilised in their deployment, given the complexity of the contextual environment in Sub-Saharan countries, would become a source of sustainable competitive advantage. They would be difficult to imitate by other countries due to causal ambiguity and time compression diseconomies that would arise in their development and subsequent deployment. The stages of technology diffusion, subsequent governance and translation into successful applications depend on sound strategic decisions regarding national ICT adoption and utilisation. Authors argue that digital applications that follow the proposed framework will bring the positive socio-economic outcomes.

Barriers in the Extended ICT Ecosystem
The Extended ICT Ecosystem model introduces a complete range of barriers identified in the ICT literature in the literature review process to devise a complete theoretical framework for development and implementation of successful, sustainable and scalable digital healthcare applications. The initial ecosystem model by Mbarika et al (2005) only shows the particular stages in ICT infrastructure investments, adoption, development, diffusion and application. The extended ecosystem includes the barriers at all of these stages that pertain to:

1. Existing ICT infrastructure in SSA and investments in its scaling and development for the purposes of digitisation of healthcare service delivery and healthcare data flows in particular

2. Adoption and development of this ICT infrastructure for the purposes of digital healthcare. These barriers are related to the required resources:

   a. **Tangible** – the ICT infrastructure must be translated into tangible resources that when developed and managed appropriately are a source of competitive advantage in the context of the socio-cultural complexity of the SSA setting

   b. **Intangible** – the resources that are embedded in socio-cultural norms and practices of development. These are to complement the tangible resources so that they can become a source of sustainable competitive advantage or in this context – a source of the desired socio-economic outcomes. Intangible resources pertain to the synergies and complementarity of the physical infrastructure with governmental, cultural, social and national norms. If such synergies do not exist, the physical infrastructure cannot be leveraged to build successful ICT healthcare applications and interventions.
c. **Human capital** – personnel resources developed through training and participation in the development and deployment of the physical infrastructure that support the integration of ICT infrastructure into ICT resources. ICT personnel operates, maintains and develops through innovative ideas the ICT infrastructure to better align it with the needs of the SSA context. Thus, human capital is the source of complementary capabilities that are required to ultimately translate the physical infrastructure into digital healthcare applications that carry the desired socio-economic impact.

In the extended Mbarika et al (2005) framework ICT infrastructure is seen as the key, overarching bottleneck to implementation of successful digital healthcare applications. This bottleneck has to be overcome through appropriate investments in ICT. Then, through simultaneous deployment of tangible, intangible and personnel-based (human capital) resources, the ICT infrastructure can be successfully adopted and developed to create infrastructure capabilities for the purposes of deploying sustainable and scalable digital healthcare applications/interventions.

Therefore, it is imperative to identify the barriers at all these various stages of the Extended ICT Ecosystem to draw a complete picture of successful digitization endeavours. These barriers then should help to unravel the antecedents of failure of digital healthcare interventions and elucidate the key aspects of successful applications that overcome these barriers. Ultimately, the Extended ICT Ecosystem was used to assess the current state of literature and its theoretical propositions on the bottlenecks to successful digital healthcare interventions by applying it to the situation in the Gambia and the additional case studies as laid out in description of the data. The following table represents the findings made by the author from the existing literature in terms of the barriers at the various stages of the framework. It manifests a thorough effort to draw a complete picture of the barriers identified by researchers and to develop a compelling conceptual framework for the analysis.
<table>
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<tr>
<th>Barriers to:</th>
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<tr>
<td>ICT Infrastructure and Investments</td>
<td>The poor state of ICT infrastructure in SSA is seen as the overarching bottleneck to digitisation endeavours in the region. Without scaling up the underlying ICT infrastructure there can be no development and implementation of successful digital healthcare applications. The following four barriers in terms of existing infrastructure were derived from the literature and encompass the key aspects of inadequate ICT infrastructure in SSA.</td>
<td>Teledensity</td>
<td>Teledensity is used as an operationalisation of ICT adoption in a country and is considered the “fundamental factor for ICT development” (Mbarika et al, 2005). Lagging teledensity is, thus, seen as the key obstacle to digitisation of healthcare in SSA.</td>
<td>Bashshur et al. (2000), Musa et al. (2005), Mbarika and Byrd (2009), Wamala and Augustine (2013)</td>
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<td>Lack of ICT infrastructure</td>
<td>A plethora of studies points to the simple scarcity of ICT infrastructure in developing countries and SSA in particular that prevents development of successful digital healthcare applications.</td>
<td>Braa et al. (2007), Barnett and Galegos (2013), Omary et al. (2009)</td>
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<td>Underutilisation of existing ICT infrastructure and failure of technology transfer</td>
<td>Seminal work by Odedra (1993a) points to the fact that much of the existing ICT infrastructure came from foreign aid where technology was dumped on the SSA countries without instruction on how to operate it and it does not reflect their needs. Therefore, the existing infrastructure is underutilised, inadequate and cannot be translated into tangible resources.</td>
<td>Odedra (1993a), Odedra (1993b)</td>
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<td>Inconsistent power supply</td>
<td>Energy shortages in SSA and the ineffective solutions such as rotating power supplies inhibit the potential of existing and developing ICT infrastructure.</td>
<td>Rotich et al. (2003), Eberhard et al. (2008), Fraser et al. (2005)</td>
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<td>Tangible resources</td>
<td>ICT infrastructure, even if appropriate and sufficient only becomes a source of rents or allows for the socio-economic impact of digital healthcare applications if it is translated into tangible infrastructure resources. These resources become a source of competitive advantage when they are &quot;unique&quot; (Mbarika et al., 2005). In the SSA context, resources become unique through their adoption in their idiosyncratic environment where time compression diseconomies, embeddedness in this context and causal ambiguity make them a source of rents and socio-economic outcomes when complemented with intangible resources and the supporting human capital. The following barriers were recognised as inhibiting the process adopting and recombining the infrastructure into these resources.</td>
<td>Restricted access</td>
<td>Existing or recently developed ICT infrastructure cannot be translated into ICT resources, because the access to the infrastructure is restricted to elites or relevant actors are precluded from its use.</td>
<td>Jensen (2001), Pigato (2001), United Nations (2014)</td>
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<td>State-owned monopoly on ICT</td>
<td>Privatisation of the ICT sector is seen as one of the key drivers of transforming ICT infrastructure into resources and successful digital healthcare applications. State-owned monopolies over infrastructure hinder the digital widespread, efficient adoption.</td>
<td>Kimura et al. (2010), Mlay et al. (2012)</td>
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<td>Prohibitively high access costs</td>
<td>A factor frequently recognised in the literature is the relatively high access costs born by actors in SSA as compared to the developed world. Costs that make widespread adoption impossible. This inequality stems from inadequate public policy, economic situation in the SSA and monopolistic structure of telecommunication providers.</td>
<td>Adam (1996), Mbarika et al. (2005)</td>
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<td>Regulation promotes vested interests</td>
<td>While the SSA has suffered from haphazard investments in ICT coming from foreign donors that implemented infrastructure inadequate for its context, some authors point to the fact that new investments perpetuate the problem as unable governments encourage such infrastructure investments.</td>
<td>De Boer and Walbeek (1999)</td>
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<td>Barriers to</td>
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<td>Global Development Network – Next Horizons Essay: Description</td>
<td>Competition: Winning Essay Description</td>
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<tr>
<td>Intangible resources</td>
<td>Governmental</td>
<td>Governments of the SSA countries suffer from poor capability. Regulation and policy does not create an environment conducive of supporting the tangible ICT resources for development of successful digital healthcare applications.</td>
<td>Lack of regulation on privacy and confidentiality: Privacy and confidentiality of digitised data for the benefits of healthcare service delivery is not engraved in policy what hinders utilisation of the tangible ICT resources and development of successful digital healthcare applications.</td>
<td>Omary et al (2009)</td>
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<td></td>
<td>Lack of government support and central authorities collaboration: Government officials and other decision-making bodies within the governmental and healthcare service delivery function do not recognise the opportunity that ICT carries and are not inclined to cooperate in development of digital healthcare applications.</td>
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<td>Braa et al. (2007), Gichoya (2005), Igira et al. (2008)</td>
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<tr>
<td>Intangible resources</td>
<td>Cultural</td>
<td>Africa is traditionally an oral culture. The transition towards a reading culture and one that could embrace data and digital data in particular for the purposes of improving the healthcare delivery service is still undergoing. This barrier particularly pertains to slow adoption and poor sustainability of digital healthcare applications.</td>
<td>Resources not tied to cultural needs</td>
<td>The existing infrastructure and ICT resources do not reflect the particular needs of cultural contexts in SSA. These are related to localisation of ICT infrastructure in terms of language but also codes of conduct.</td>
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<td>Lack of data culture</td>
<td>The cultural contexts in SSA vary and determine the likelihood of adoption and development of tangible ICT resources for healthcare. Lack of data culture makes applications unsustainable as users retreat to culturally embedded modes of operation.</td>
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<td></td>
<td>Social</td>
<td>Beyond cultural factors, social processes in the SSA, raging socio-economic inequality within the societies leads to disparities in potential for ICT adoption and translation of ICT infrastructure and resources into successful digital healthcare applications.</td>
<td>Relevant actors do not perceive the potential benefits of ICT. Limited demand for technology.</td>
<td>This is related to the cultural dimension of barriers to deployment of intangible resources and represents the overall societal attitude to technology, which is not seen as an enabler of positive socio-economic outcomes.</td>
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<td>Urban/Rural divide in access and understanding of technology.</td>
<td>For the benefits of digital healthcare applications built upon tangible ICT resources to be realised, access has to be universal rather than confined to rural areas. The urban/rural divide in access is frequently quoted as an obstacle to digitisation.</td>
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<td>Human Capital</td>
<td>Human capital or “Personnel-based resources” (Mbarika et al., 2005) are</td>
<td>Lack of ICT</td>
<td>Underinvestment in education, especially in IT, and “brain-drain” leave SSA a region with poor human resources critical to translation of tangible and intangible assets into capabilities for implementation of impactful digital healthcare applications.</td>
<td>Ngulube (2007)</td>
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<td>critical for appropriate deployment of tangible and intangible resources for</td>
<td>personnel</td>
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<td>development, diffusion and application of digital healthcare interventions.</td>
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<td>The scarcity of human capital, education, ICT literacy and the “brain-drain”</td>
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<td>are a major obstacle to digitisation of healthcare delivery processes and data</td>
<td>ICT literacy</td>
<td>While information literacy is seen as indispensable to translation of ICT resources into rent-generating, impactful applications, poor ICT literacy in SSA is quoted as one of the key bottlenecks to development in the information age.</td>
<td>Braaksma (2004), Ngulube (2007), Igira et al (2007)</td>
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<td>flows digitisation in particular. Without local human capital, sustainability of</td>
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<td>these endeavours cannot be engrained. The following barriers are the key</td>
<td>Inadequate/lack of</td>
<td>Digital healthcare applications, especially those developed in the Western countries and implemented in SSA in a haphazard manner neglect the need of offering appropriate training to local personnel undermining sustainability of the solution.</td>
<td>Kuruvilla et al. (2004) and various case study reports of digital healthcare interventions</td>
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<td>problems related to this overarching barrier.</td>
<td>ICT training</td>
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<td>No local human</td>
<td>Related to the previous barrier, lack of local human capital involvement in development process first undermines sustainability of applications once foreign aid ends. Second, it prevents from scaling up the local human capital. Finally, it hinders adoption and context-specific application development.</td>
<td>Norris (2001), Mbarika et al. (2005)</td>
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</table>
The barriers presented in the tables above substantiate the initial Mbarika et al. (2005) framework to provide a complete theoretical tool for analysis and digital application development, are not exhaustive. Still, they are the most overarching issues identified in the literature and contribute to understanding of failure and success of digital healthcare applications. An approach to digitisation of healthcare delivery services and data flows in particular that follows the propositions of this Extended ICT Evosystem and that addresses these barriers should be implemented and achieve sustainability and scalability. However, as shown in this essay, whatever these barriers might be and however successful a particular solution might be in addressing them, it will never be sustainable unless it addresses the overarching bottleneck identified in this study – lack of Holistic Approach. Without reflecting the underlying complexity of healthcare delivery services, the untangled puzzle that persists, applications deployed to address these significant barriers are likely to fail. Removing these obstacles will be critical to embark on a path towards successful digitisation of healthcare delivery services in SSA and other developing countries, but without addressing this underlying issue, as elucidated in this essay, this success is unlikely to materialise in the long term.
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