

DIGITAL HEALTH INNOVATION ECOSYSTEMS: IDENTIFYING KEY PARTICIPANTS, BENEFITS, CHALLENGES AND GUIDELINES FOR THE NAMIBIAN CONTEXT

ABSTRACT

The term Digital Health Innovation Ecosystem is used to describe a platform where patients and healthcare stakeholders can collaborate on improving patients' health through the use of digital health technologies. Different studies have described Digital Health Innovation Ecosystems in developed and developing countries. Although the components of a Digital Health Innovation Ecosystem have been identified within the Namibian context, a discussion around the human participants to drive the proposed ecosystem is missing. Furthermore, the benefits, challenges and implementation strategies of the Digital Health Innovation Ecosystem within the Namibian context are not known. The purpose of this paper was to identify key participants, benefits and challenges of a Digital Health Innovation Ecosystem in Namibia. The study also aimed to present the guidelines for implementing a Digital Health Innovation Ecosystem for the Namibian context. This is a qualitative study which adopted semi-structured interviews in meeting the objectives of the study. The findings suggest that implementing Digital Health Innovation Ecosystems within the Namibian context will result in better processes of delivering healthcare services to patients and improving work processes and communication between medical practitioners. However, implementing such an ecosystem would require resources from both governmental organisations. The need for skilled experts for managing the ecosystem would also be required. Hence, adopting the guidelines for implementing a Digital Health Innovation Ecosystem in developing countries, the study proposed guidelines with approaches which would make Digital Health Innovation Ecosystem work for the Namibian context. The findings of this study can be used by healthcare managers within the Namibian context as a guideline for implementing a Digital Health Innovation Ecosystem.

Keywords: Digital Health Innovation Ecosystems, Participants, Benefits, Challenges, Guidelines, Namibia.

INTRODUCTION

Implementing digital health in developing countries has become a challenge (Herselman et al., 2016). Hence, researchers and health professionals are coming up with strategies on best practices to implement digital health in developing countries. An example of such strategies is Digital Health Innovation Ecosystems proposed by Herselman et al. (2016). Iyawa et al. (2016a) further suggest that digital health can be implemented in developing countries through the application of innovative principles.

Different studies on Digital Health Innovation Ecosystems have described the concept and what it consists of (Iyawa et al., 2016a; Iyawa et al., 2016b; Mehl, et al. 2018; Labrique, et al., 2013;) both in developed and developing countries. Digital health, the use of digital, mobile and wireless technologies for health (ITU, 2015), is being positioned as a transformative agent, particularly in low-income and middle-income settings, where mobile connectivity has reached unprecedented penetration and ubiquity (GSMA Intelligence. 2018). In the World Bank (2015) report: Multilateral

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initiatives such as the Roadmap for Health and Measurement and Accountability advocate the ‘use of the digital revolution to scale-up health interventions and engage civil society’, and monitor health systems’ performance and accountability to beneficiary populations. Over the past decade, numerous digital health strategies have emerged to address long-standing health system challenges, and achieve national and global goals including the United Nations Millennium Development Goals (MDGs) and United Nations Sustainable Development Goals (SDGs) (Asi and Williams, 2018; Labrique, et al., 2013; Mehl et al., 2014).

Since 2001, governments, donors, global development agencies, and civil society have been mobilized to action by the universally ratified United Nations Millennium Development Goals (MDGs) (UN Millennium Project, 2005). These eight ambitious objectives, established to improve quality of life across the globe, include three specific health objectives (MDGs 4, 5, 6) with others—such as the eradication of poverty and hunger and the promotion of gender equality—that are clearly necessary to enable significant improvements in health outcomes (Konduri, et al. 2018). MDG 4 focus on improving child mortality, MDG 5 focus on improving maternal health and MDG 6 focus on combating HIV/AIDS, malaria and other diseases (UN Millennium project, 2005). National health system–strengthening initiatives and multi-country and multisectoral programs were funded and launched to accelerate progress toward the MDGs by the 2015 target date (Konduri et al., 2018). Reliable information systems are crucial to support policy-makers and leaders working toward the MDG 4, 5 and 6 targets, particularly ensuring quality, efficiency, and safety in Universal Health Coverage (Mehl, et al., 2018).

Despite the global abundance of digital health implementations, few have achieved national-level scale or become institutionalised as a routine practice within the Ministries of Health (Mehl et al., 2018). Furthermore, successes are often defined as technical accomplishments, instead of demonstrated impact on programme or health outcomes (Huang, Blaschke, and Lucas, 2017). MomConnect, in South Africa, represents a rare example of a nationally scaled and government-supported digital health initiative (Mehl, et al. 2018).

It is also argued that the concept of Digital Health Innovation Ecosystems can support developing countries in attaining the Millennium Development Goals (MDGs) (Iyawa et al. 2017b). This is especially relevant to MDGs number 4, 5 and 6. The relevant components of a Digital Health Innovation Ecosystem for the Namibian context have also been identified (Iyawa et al., 2017a). Iyawa et al. (2016a, 2016b) emphasize that the foundation of Digital Health Innovation Ecosystems includes digital health, innovation and digital ecosystems. Although the components that make up a Namibian Digital Health Innovation Ecosystem is known, the participants of this ecosystem, as well as the benefits and challenges of implementing such an ecosystem, as well as the benefits and challenges of implementing such an ecosystem has not been discussed. Furthermore, there is no guideline to explain how the identified Namibian Digital Health Innovation Ecosystem components can be implemented.

The purpose of this paper was to identify key participants who will participate in transactions carried out in the ecosystem for the Namibian context. This is to identify and describe specific professionals as well as their role in the ecosystem, hence, contributing to the empirical research on participants of a Digital Health Innovation Ecosystem. Another significant contribution of this paper is the identification of the benefits, challenges and presentation of guidelines for

implementing a Digital Health Innovation Ecosystem for the Namibian context which would enable the actual implementation of the ecosystem. This paper also supports the strengthening of the MDGs 4,5 and 6 specifically through the Digital Health Innovation Ecosystem.

The remainder of this paper is structured as follows: section 2 presents the literature review of Digital Health Innovation Ecosystems. Section 3 describes the research methodology. Section 4 presents the results of the study. Discussions, as well as the guidelines with approaches for implementing a Digital Health Innovation Ecosystem for the Namibian context, as well as the guidelines with approaches for implementing a Digital Health Innovation Ecosystem for the Namibian context, are presented in Section 5. Conclusions are made in Section 6.

BACKGROUND LITERATURE REVIEW

Digital health and digital health innovation

Digital health is described as “an improvement in the way healthcare provision is conceived and delivered by healthcare providers through the use of information and communication technologies to monitor and improve the well-being and health of patients and to empower patients in the management of their health and that of their families” (Iyawa et al., 2016, p3). The benefits of digital health are enormous. For example, digital health is capable of resolving challenges regarding distances in accessing healthcare services through the use of mobile applications and telemedicine services (Asi and Williams, 2018). Asi and Williams (2018) further emphasise that digital health can support maintaining patient data through the use of cloud computing services and electronic medical records. However, it is also important that these technologies interact with each other to fulfil the objectives of implementing these technologies. Were et al. (2016) explain that digital health can support treatment of illnesses. It is therefore evident from the literature that digital health brings a new dimension to healthcare delivery.

Herselman et al. (2016) are of the opinion that implementing digital health in developing countries should apply innovative approaches, and as a result, developed the concept of Digital Health Innovation Ecosystems to address the challenges involved in implementing digital health in these countries. The concept of Digital Health Innovation Ecosystems was further permeated by Iyawa et al. (2016a). Iyawa et al. (2016a, p.3) defined Digital Health Innovation Ecosystems as “a network of digital health communities consisting of interconnected, interrelated and interdependent digital health species, including healthcare stakeholders, healthcare institutions and digital healthcare devices situated in a digital health environment, who adopt the best-demonstrated practices that have been proven to be successful, and implementation of those practices through the use of information and communication technologies to monitor and improve the wellbeing and health of patients, to empower patients in the management of their health and that of their families”. The definition provided by Iyawa et al. (2016a) point out the key composition of Digital Health Innovation Ecosystems such as healthcare stakeholders, healthcare institutions and digital health technologies.

Digital Health Innovation Ecosystems consists of three main components which are digital health, innovation and digital ecosystems (Iyawa et al., 2016b). These components are important in establishing a complete Digital Health Innovation Ecosystem. The ecosystem includes a mixture of

innovation principles in providing healthcare services to patients as well as the use of digital health technologies. Iyawa et al. (2016b) suggest that such a platform would facilitate the input of patients' and other health stakeholders' idea through different innovation strategies such as open innovation and Quadruple Helix. Iyawa et al. (2016b) presented a conceptual framework for Digital Health Innovation Ecosystems to describe how the different components interact with each other.

Moving the discussion of Digital Health Innovation Ecosystems from concepts to experiences, Iyawa et al. (2017a) conducted a scoping review of how the concept of digital health, innovation and digital ecosystems have been implemented in developed and developing countries. The findings suggest that each concept has been implemented in both developed and developing countries. Hence, Digital Health Innovation Ecosystems can be implemented in Namibia.

2.2 Factors affecting the implementation of digital health

Digital health is related to technologies, as most of the components are technology related (Robinson et al., 2015; Lupton, 2014; Alemdar and Esroy, 2010; Till, 2014; Appelboom et al., 2013). This further places an issue on costs. The implication is that for digital health to be deployed in a context, several technologies need to be in place to facilitate the process. In certain countries, the cost might thus hinder the implementation. Hence, health financing must be improved to facilitate the implementation of digital health technologies.

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A lack of qualified healthcare practitioners in developing countries has been identified as a challenge (Bangdiwala et al., 2010; Moxon et al., 2015). Human resources, such as skilled healthcare practitioners, might also pose a threat to the implementation of Digital Health Innovation Ecosystems in developing countries. Practitioners with adequate skills regarding Digital Health Innovation Ecosystems are needed to run the program and, as such, healthcare practitioners in developing countries might have to update their skills.

Leadership and governance in the drive towards health innovation ecosystems are important. As indicated by Moxon et al. (2015), leadership and governance in healthcare management is a challenge in developing countries and, as such, it might also be a challenge when implementing Digital Health Innovation Ecosystems in developing countries. As such, adequate plans should be made to manage leadership and governance in health systems in developing countries and to facilitate Digital Health innovation ecosystems ~~so as to facilitate Digital Health innovation ecosystems~~. Concepts, like open innovation, where ideas are shared across organisations (European Union, 2016), have a role to play in this regard.

2.3 Digital Health Innovation Ecosystems for the Namibian context

Namibia is a Southern African country. The Namibian healthcare system is divided into public and private healthcare systems (Stiftung, 2012). A study by Hamunyela and Iyamu (2013) indicates that the Namibian healthcare system adopts the use of information technologies, however, not to larger extent. It is reported that healthcare delivery in rural communities in Namibia is insufficient (MoHSS, 2017). There is a dearth of medical doctors in rural communities in Namibia, and as such

patients are usually left with nurses who do not have the expertise to attend to the needs of the patients (Awases, 2006). Although there have been suggestions to support healthcare delivery in rural communities in Namibia (Iyawa and Coleman, 2015; Dansharif, Dlodlo and Angula, 2018). There is a need to explore digital health and ultimately, the introduction of Digital Health Innovation Ecosystems in the Namibian healthcare system. Identifying key participants, benefits, challenges of this ecosystem would ~~in the long run, in the long run~~ support the implementation strategies. Guidelines for implementing a Digital Health Innovation Ecosystem for the Namibian context would facilitate the actual implementation of the ecosystem in Namibia.

RESEARCH METHODOLOGY

In order to answer the research questions posed in this study, a qualitative approach was adopted. A qualitative approach is necessary when it is important to answer the “what, why, who” related questions (Patton and Cochran, 2002) which is similar to the research questions posed in this study. To support qualitative methods, research instruments such as semi-structured interviews are in order (Jamshed, 2014). Semi-structured interviews are mainly used when the researcher uses a mix of structured and unstructured questions depending on the scale at which the interview takes place (Jamshed, 2014).

Semi-structured interviews were used in this study to facilitate the flexibility in the discussion between the researcher and the different participants. The participants included professionals from within the Namibian context and the international community. Semi-structured interviews were conducted with twenty professionals from the Namibian context in the e-health domain, innovation domain and computer networks domain. Semi-structured interviews were also conducted with fifteen professionals from the international community in the e-health and digital health domain, innovation domain and digital ecosystems domain. Each interview lasted for approximately twenty minutes, and each interview was recorded and later transcribed. While face-to-face interviews were held with the Namibian participants as one of the authors had access to the participants in Namibia, the participants from the international community were interviewed through ~~S~~skype interviews (Iacano et al., 2016). Before each interview, the participants were briefed ~~on~~about the topic. Participants from the international community were briefed about the Namibian context and how the healthcare system works in Namibia before the interviews were conducted. One of the researchers had access to participants in Namibia, ~~H~~however, the researchers did not have access to participants in the international community. The reason participants were selected in the domain of e-health, digital health, innovation and digital ecosystems is because Iyawa et al. (2016a) suggest that these elements are the building blocks of Digital Health Innovation Ecosystems, hence it was relevant to include participants who had knowledge in the domain. However, it was not possible to select participants from the digital ecosystems domain because it is a relatively ~~n~~ew concept in Namibia as such computer networks experts were selected as digital ecosystems share similar background (Chang and West, 2006). The participants in the study were purposively selected to include participants who were knowledgeable in the field. This paper aimed to answer the following research questions:

- Who constitute participants of a Digital Health Innovation Ecosystem for the Namibian context?
- What are the roles of participants of a Digital Health Innovation Ecosystem for the Namibia

context?

- What are the benefits and challenges of implementing a Digital Health Innovation Ecosystem for the Namibian context?
- What are the guidelines for implementing a Digital Health Innovation Ecosystem for the Namibian context?

The participants of the study are described in table 1.

Table 1 Participants in the study.

Field	Number of participants from Namibia	Number of participants in the international community	Total
Digital health/e-health Innovation	7	5	12
Digital Ecosystems/Computer Networks	5	5	10
	8	5	13

In total, twenty participants from within the Namibian context participated in the interviews, and 15 participants from the global context (Portugal, Germany, Finland, Ireland, Nigeria, Italy, Taiwan, Australia, the United Kingdom, the United States, Brazil, South Africa) participated in sSkype interviews. Medical doctors, Information Technology (IT) professionals in healthcare, academics and researcher and innovation organisations participated in the study. Participants from within the Namibian context were medical doctors, Information Technology (IT) professionals in healthcare, professors and lecturers, researchers from innovation organisations and networking professionals. Although participants were from different fields, they had an understanding of the principles of innovation. In order to answer the research question “What are the guidelines for implementing a Digital Health Innovation Ecosystem for the Namibian context?”, the guidelines for implementing a Digital Health Innovation Ecosystems for developing countries proposed by Iyawa et al. (2017b) were adopted and based on the experiences of the researched proposed the guidelines for implementing a Digital Health Innovation Ecosystem for the Namibian context.

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RESULTS

The findings are categorised under two headings: Participants and their roles in the Namibian Digital Health Innovation Ecosystem and benefits and challenges of implementing a Namibian Digital Health Innovation Ecosystem. Each category covers the findings from both Namibian participants and the International participants.

4.1. Participants and their roles in the Namibian Digital Health Innovation Ecosystem

Participants were asked during the interviews to identify the key participants in a Namibian Digital Health Innovation Ecosystem and their role in such an ecosystem. Different participants presented different ideas on who would fit in a Namibian Digital Health Innovation Ecosystem. For example, three participants (researchers) indicated that researchers would be appropriate members as one of them stated: *“As a researcher myself, I would be very interested in participating in such an ecosystem through research”*. Another participant stated: *“I would gladly serve ~~in~~ such an ecosystem as a researcher as I would like to share knowledge”*.

Five participants ~~with~~in the innovation sector and healthcare sector suggested patients ~~to~~ be essential members of the ecosystem. It was also indicated that patients would receive service on this platform as one participant indicated *“patients are definitely going to be part of the digital health innovation ecosystem because they are the main users, the focus is to provide healthcare services for them, and it would be of no use if they are not involved. Patients would play a significant role as they would be involved in user innovation”*. Communication is one of the main roles of patients in the ecosystem as another participant commented: *“Patients can also be involved in communicating with their respective healthcare service provider and medical practitioners”*. Another participant commented: *“...with the use of digital technologies like mobile phones and telemedicine systems, patients can communicate with medical practitioners and services can be provided with these technologies.”* It was also stated that open innovation would be important as patients can share information on how their health can be managed.

Another group of participants relevant to the Namibian Digital Health Innovation Ecosystem suggested by participants in the healthcare domain are the medical practitioners. It was further stated by another participant. When asked what roles medical practitioners would play in the Namibian Digital Health Innovation Ecosystem, participants from the healthcare sector explained that they should support healthcare provision to patients and provide information sharing to other participants in the ecosystem through the use of digital technologies.

The participants from the innovation sector were of the opinion that innovation experts are essential in the Namibian Digital Health Innovation ecosystem as they would apply innovation concepts which include open innovation and intellectual property rights to manage information and knowledge shared on the platform.

Participants who have a background in the computer networks field, as well as the digital ecosystems, as well as the digital ecosystems, field strongly opine that ICT experts will be key stakeholders in the ecosystem as it would need technical support to run and manage the digital technologies that will be used in the ecosystem. It was further stated that IT professionals would facilitate the interaction between the digital technologies and the human participants.

It was also suggested that government institutions, innovation firms and research institutions would need to be on the platform to support innovation in the ecosystem.

4.2. Benefits and challenges of a Namibian Digital Health Innovation Ecosystem

Participants were asked about the likely benefits and challenges of implementing such an ecosystem in a developing country such as Namibia. All participants believed that the proposed ecosystem presents some benefits and there would be challenges in implementing such an ecosystem in the Namibian context. One of the participants in the healthcare sector commented on the benefits of a Namibian Digital Health Innovation Ecosystem “...when this ecosystem is implemented, it will be a common platform for all health practitioners to share information and seek advice from professionals.” As such, information sharing was pointed as one of the benefits of a Namibian Digital Health Innovation Ecosystem as another participant from the digital ecosystems field indicated “...doctors can interact, share information and even patients can be part of the ecosystem when they participate in this kind of ecosystem.”

Another participant opines that such an ecosystem will provide a platform where innovation can be enforced as “users will have the opportunity to keep the intellectual property right, I like the concept of user innovation, where innovative ideas are not only left in the hands of the professionals. Users, in this case, patients, can also share their ideas regarding what they want and this might bring about improved processes as well.”

A participant from the innovation field explained that a Namibian Digital Health Innovation Ecosystem would have a positive effect on the health care service delivery. It was identified that a significant benefit of a Namibian Digital Health Innovation Ecosystem would be the realization of better and efficient ways of providing healthcare services and improvement in the way healthcare is delivered to patients.

In addition, participants indicated that collaboration between healthcare institutions, innovation companies would be addressed by the Namibian Digital Health Innovation Ecosystem. One participant from the digital ecosystems field suggested that the health-related Millennium Development Goals (MDGs) can be addressed with the implementation of the Namibian Digital Health Innovation Ecosystem as it would facilitate better healthcare delivery services on this platform and as such, improve the life of patients.

Participants also believe that the benefits of a Namibian Digital Health Innovation Ecosystem would be to improve efficiency and effective of healthcare systems in Namibia. It was also pointed that interoperability issues in Namibian healthcare systems can also be addressed with a Namibian Digital Health Innovation Ecosystem.

Participants were asked to explain the likely challenges to be encountered in the implementation of such an ecosystem in the Namibian context. The challenges identified by the participants include resources, including human resources for maintaining the ecosystem, financial resources. One of the participants states “This ecosystem would require skilled experts to manage how the system works...” Another participant indicated that cost of technologies would be a major challenge in implementing such an ecosystem as the ecosystem would be reliant on digital technologies and as such would require financial support from the government.

One participant from the healthcare sector indicated that it would take a long process to adapt toby the participants as it is a new process that needs to be learned. It was also indicated that policies and policies would need to be redefined which might turn out to be a challenge since the commencement of activities in the ecosystem would depend on these policies and procedure changes.

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DISCUSSION

This study investigated the key participants, benefits and challenges of a Namibian Digital Health Innovation Ecosystem. The study also presented the guidelines with approaches on how to implement the ecosystem. This study contributes to the empirical research on identifying participants of a Digital Health Innovation Ecosystem as well as the benefits, challenges and guidelines for implementing a Digital Health Innovation Ecosystem for the Namibian context which would enable the actual implementation of Digital Health Innovation Ecosystems in the Namibian context.

Consistent with the findings from other studies on digital ecosystems in the healthcare domain, our study suggests that Namibian Digital Health Innovation Ecosystem also consists of participants in the healthcare domain (Serbanati and Visilateanu, 2011). The inclusion of healthcare participants in the ecosystem is necessary because they provide healthcare services within the domain- and as such, form one of the core participants in the ecosystem. The study found researchers to be key participants in the ecosystem; this is inconsistent with previous research as researchers have not been pointed to be participants in a digital ecosystem. This could be as a result of Digital Health Innovation Ecosystems not being investigated in other contexts. The paper also contributes to the theory on implementing digital health innovation ecosystems especially in developing contexts and also highlights the importance of using context-specific feedback to improve or enhance a theoretical framework from the literature on the definitions of digital health, innovation and digital ecosystems.

Patients were seen to be another important group of participants in the ecosystem. This is similar to other studies that suggest that patients should take part in the health delivery process (Pomey et al., 2015). Government and other institutions are also seen as participants in the organisation. This is in line with other studies (Chang and West, 2006) that indicate institutions also make up an ecosystem.

Collaboration and information sharing seems to be benefits of a Namibian Digital Health Innovation Ecosystem as indicated by the participants. This is consistent with the findings of Um et al. (2015) and Debay et al. (2012) which indicates that participants in an ecosystem can share information and interact.

The findings of this study indicate that interoperability will enabled when the ecosystem is formed within the Namibian context. This is similar to the findings provided by Dorloff (2010) and Lurgi and Estanyol (2010) which suggests that interoperability is an important feature in an ecosystem.

The participants of the study are in agreement that a Namibian Digital Health Innovation Ecosystem would bring about improved healthcare services and facilitate Namibia in meeting the health-related MDG (4, 5 and 6) which is in line with the findings of Iyawa et al. (2017b) which postulates that Digital Health Innovation Ecosystems can improve healthcare services and facilitate developing countries in meeting the health-related MDGs. However, the challenges facing the implementation of such ecosystems include financial and human resources; this is not in line with other studies on digital ecosystems which suggest that trust (Delina et al., 2012) and security (Savola and Sihvonen, 2012) seem to be challenges facing digital ecosystems. This could be as a result of Digital Health Innovation Ecosystems not previously studied in other contexts to compare these challenges.

Skilled experts would be one of the major constraints in developing a Namibian Digital Health Innovation Ecosystem. However, this has not been pointed out in previous studies.

The guidelines with approaches for implementing a Digital Health Innovation Ecosystem for the Namibian context are presented in the next section.

5.1. Guidelines with approaches for implementing a Digital Health Innovation Ecosystem for the Namibian context

The six guidelines, with approaches, towards implementing a digital health innovation ecosystem in developing countries, were provided by Iyawa et al. (2017b). However, said guidelines would be adapted to explain the specific guidelines to implement a digital health innovation ecosystem in the Namibian context. The guidelines are described below:

5.1.1 Guideline 1: Identification of stakeholders and their role in the ecosystem

Identifying stakeholders in the Namibian Digital Health Innovation Ecosystem is the first step towards implementing this ecosystem in Namibia. Namibian stakeholders include: patients, healthcare practitioners (doctors, nurses, pharmacists and other healthcare practitioners from both public and private hospitals in Namibia), public and private hospitals and public and private clinics, researchers and academics from Universities and the Universities of Technology, research centres and Information technology experts with experience in health information systems. These stakeholders can be located in any of the 14 regions in Namibia.

Every stakeholder (i.e. patients, healthcare practitioners, health institutions, researchers and IT professionals from within the Namibian context) will play a role within the ecosystem in the domain of their expertise. Healthcare practitioners will perform healthcare delivery related activities using digital health technologies, such as telemedicine, and so interact with patients in the digital health innovation ecosystem. Using telemedicine, healthcare professionals can consult with patients who reside in a distant location. Other digital health components, as specified by Iyawa et al. (2017b), can also be used by healthcare practitioners and patients to deliver and manage healthcare. Health institutions can provide support by sharing information with other health institutions to

reach an agreement, via the correct communication channels, regarding the use of healthcare resources for the delivery of healthcare services. Researchers and academics can conduct research which will lead to innovation and new ideas which can promote innovation in the delivery of healthcare services. IT professionals taking part in the ecosystem can provide technical support for the various technologies deployed.

Chang & West (2006) suggest that species in a digital ecosystem should be self-organised. This implies that participants should be free to make their own decisions. Therefore, the decision to join the Namibian Digital Health Innovation Ecosystem or to withdraw from it, ultimately lies with every stakeholder. To implement this process, the use of certain platforms such as social media, social networks, health and medical platforms can be developed and then, stakeholders can join and withdraw, at will.

5.1.2 Guideline 2: Connecting international through local

Global stakeholders should also be allowed to join in the establishment of a Namibian Digital Health Innovation Ecosystem. Global stakeholders include healthcare practitioners (doctors, nurses and other healthcare practitioners), health institutions, researchers, academics and consultants outside the Namibian context. These stakeholders can impart ideas, knowledge and skills beneficial to the stakeholders in the Namibian context. In this manner, ideas and knowledge are shared between local and global entities. The incorporation of innovation processes will ensure that shared ideas and knowledge is beneficial to all stakeholders

Implementing platforms (such as social networks, social media presence and health and medical platforms) is a possible way to connect local and international participants. The Namibian government should draw up policies which govern intellectual property rights and other possible benefits which may arise from the sharing of information within the Namibian digital health innovation ecosystem

These benefits can be applied to patients, medical practitioners, researchers, health institutions, consultants or any entity represented in the ecosystem. For instance, if a private health organisation, from either a Namibian or global context, shares an idea with other stakeholders in the ecosystem, then that private health organisation owns the intellectual property to said shared ideas. If the ideas turn out to be beneficial, the private health organisation is to be rewarded. The same principle can be applied to all stakeholders participating in the ecosystem.

5.1.3 Guideline 3: Organising Requirements

The Namibian context can take up components (identified by Iyawa et al., 2016a) which can be explored in the digital health innovation ecosystem. Due to resource constraints, the implementation of all digital health components at the same time (especially components related to technology) may prove to be difficult. However, one component can be explored whilst other components are being added. For example, m-health can be explored and adopted by healthcare practitioners to provide

healthcare services to patients in the ecosystem. Components of innovation and digital ecosystems can also be incorporated. For example, implementing open innovation where ideas are shared not only in a single organisation or context, but within the Namibian context and in the global context and intellectual property rights, in which ownership of ideas and knowledge remains with the producer.

All components needed within the Namibian context have been identified by in a Delphi study conducted by Iyawa et al. (2017a). All components related to digital health technologies, innovation and digital ecosystems needed for the implementation of a Namibian Digital Health Innovation Ecosystem were identified. These components **include** are illustrated in Figure 1.

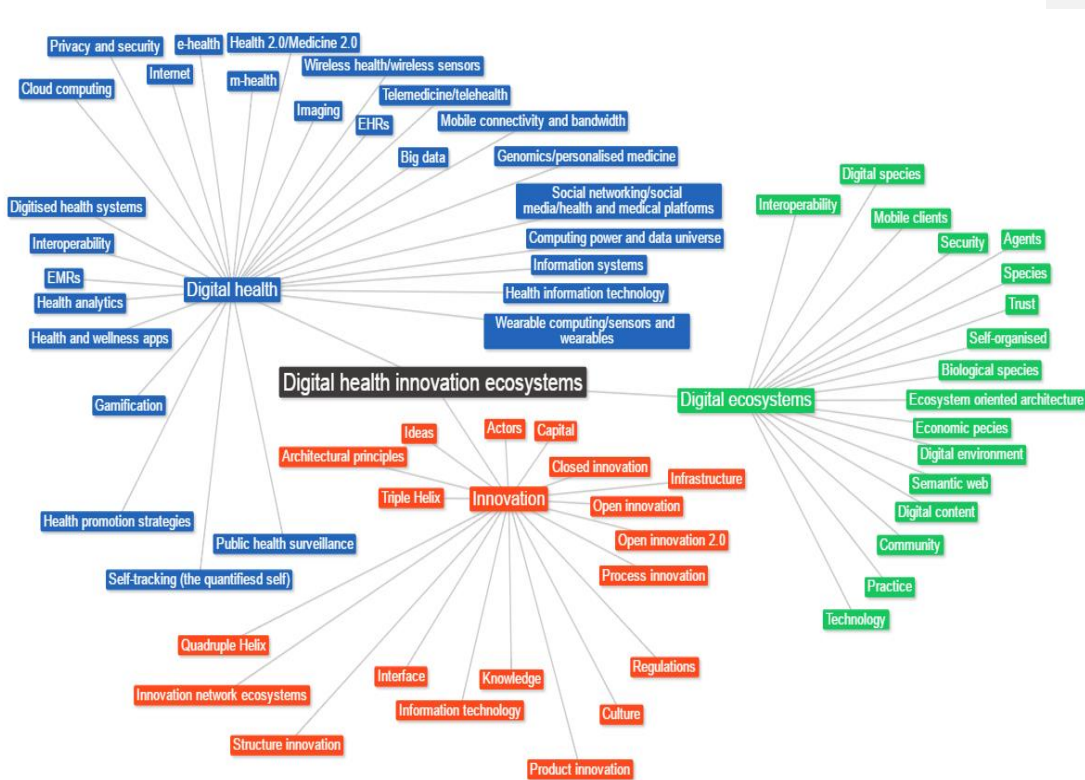


Figure 1: Components of a Namibian Digital Health Innovation Ecosystem (Iyawa et al. 2017a)

The Namibian government can thus adopt each component at the correct stage of development.

5.1.4 Guideline 4: Defining the operational environment

Since this platform interconnects patients, individuals, medical professionals, researchers and consultants, both locally and internationally, the operational environment can be deployed in a cloud computing environment, as indicated in a study conducted by Iyawa et al. (2017a). The technologies will be deployed on this platform. Seeing that the stakeholders are from different environments, the need arises for a single environment wherein technologies can be accessed. The adoption of the appropriate cloud computing model is essential as applications such as Electronic Medical Records, Electronic Health Records and Health Information Systems will need to be deployed in this cloud. For example, if a doctor in Namibia needs a second opinion from a global expert regarding a patient's diagnosis, the global expert can access the specific patient's information in the EMR, which is deployed in the cloud. However, issues such as privacy and security need to be addressed to maintain the confidentiality of the relevant information.

5.1.5 Guideline 5: Align the existing healthcare applications with the new digital health applications

At this point in time public and private health institutions have their own systems. New digital health applications, developed to service the digital health innovation ecosystem, will need to interact with existing systems. Interoperability can be achieved when new digital applications are developed in such a way that patient health information (stored in existing Namibian health institution systems) can be accessed. Information does not need to be duplicated, hence continuing the work-flows. Interoperability can be achieved through the introduction of e-health interoperability standards for e-health systems. The governing body of health institutions in Namibia, in conjunction with global experts in interoperability standards, can select which e-health interoperability standards to deploy.

5.1.6 Guideline 6: Review, monitoring and ethics

The government of Namibia should devise policies to ensure that activities taking place within the digital health innovation ecosystem are reviewed and monitored. These policies, as determined by the Namibian government, should include: assessing the productivity and benefits of activities carried out and identifying the challenges encountered in the ecosystem. The period at which the review and monitoring should occur can be either annually, or biannually. Those individuals, or organisation/s, responsible for carrying out the review and monitoring should also be identified in the policy.

As a means of controlling access to information and how information is shared within the digital health innovation ecosystem, ethical guidelines should be defined.

CONCLUSION

In conclusion, the paper identified the key participants of the Namibian Digital Health Innovation Ecosystem as well as the benefits and challenges of implementing such an ecosystem and how this system does have the potential to support the MDGs 4, 5 and 6. This adds to the theory of fr what

such an ecosystem can do to support a developing country. Furthermore, the paper also provided guidelines with approaches on how to implement a Namibian Digital Health Innovation Ecosystem. Conversely, different interviewing tools were used to gather information from the Namibian context and the international community. One of the researchers had access to participants in the Namibian context, hence has a face-to-face semi-structured interview, however, they did not have physical access to the international community. Hence, Skype interviews were used. This could have had an impact on the findings. Furthermore, the researchers could not identify participants who are digital ecosystems experts from within the Namibian context and hence, consulted participants in the computer networks domain as Chang and West (2006) explain that computer networks and digital ecosystems have similar backgrounds. One limitation of this paper is that experts in digital health from Namibia could not be found and inputs from government officials were very difficult to pursue. Innovation in health is also not yet evident in Namibia.

The findings of the study could inform healthcare managers in the Namibian context about the eminent benefits and challenges of implementing a Namibian Digital Health Innovation Ecosystem. The guidelines with approaches to implementing a Namibian Digital Health Innovation Ecosystem presented in this study could be used to implement the ecosystem.

It would be interesting to implement such an ecosystem within the Namibian context and examine how it works. As such, future work would be actual implementation of a Namibian Digital Health Innovation Ecosystem.

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