Increasing Need for an eHealth Impact Framework for Africa

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Abstract

\textbf{Background:} Efforts by African countries to improve healthcare and citizens’ health within challenging resource limitations put considerable pressure on investment decisions. eHealth is believed to have potential to strengthen health systems and is now seen by some entities as a determinant of health, yet its impact is not well estimated in advance or measured after implementation. This is an obstacle to the effective allocation of healthcare resources and limits national and regional abilities to develop eHealth and realise its potential in health systems transformation.

\textbf{Objectives:} A broad conceptual framework for appraising eHealth impact could help selection of the best course of action by informing individual steps, including: identification of promising initiatives, choosing between eHealth options, motivating for financing, managing implementation, preparing for obsolescence, analysing achievements, and promoting sustainability. Such insight could help strengthen and transform healthcare, provide benchmarks for oversight and Monitoring and Evaluation (M&E), and improve individual and population health. Such frameworks exist, but do not address the needs of African countries.

\textbf{Methods:} Desktop literature review to explore African countries’ eHealth context and the need for an eHealth economic appraisal framework.

\textbf{Results:} Unique aspects of Africa’s health context are elucidated, particularly relating to resource constraints and health strengthening priorities. The influence of these aspects on eHealth development, and how to address factors such as affordability, value for money and risk, are highlighted. Key eHealth appraisal terms are clarified.

\textbf{Conclusions:} The paper presents the role of eHealth impact appraisal in appraising eHealth options for African countries and describes aspects critical for an eHealth impact framework for Africa.

Introduction

\textbf{The need for an African eHealth Impact Appraisal framework}

No eHealth initiative should be integrated into a health or healthcare system until its probable impacts have been appraised. This is the role of an eHealth Impact (eHI) appraisal framework. Important reasons that emphasise the importance of such a framework are the need to:

1. Compare the probable impact of various eHealth options in order to select and direct resources to the optimal option
2. Manage eHealth implementations and operations throughout their life-cycles to help secure the envisaged impact
3. Determine eHealth’s impact on health systems strengthening and transformation
4. Identify and understand realistic timescales to realise eHealth’s net benefits
5. Promote simplicity in design, content, and operation, since the expertise of the range of expected eHI users is varied, and desired data may not be readily available or accessible.

There is growing pressure to show positive impacts for any given investment. Increasingly, citizens expect health officials to take beneficial eHealth investment decisions and be accountable for how they use available resources, for both promoting people’s health and providing healthcare. For eHealth, the pressure is increased by several factors: the diversity of views on what eHealth means and the role it should play; the lack of benchmarks for good practice in eHealth implementation, benefits realisation, and eHealth impact appraisal; and a lack of consensus on what positive impact means and how success or failure should be measured. Without a rigorous framework to guide assessment of these factors, uncertainty prevails and the likelihood of good decisions being taken diminishes.

As African countries expand their eHealth initiatives and face increasingly complex choices of new and changing opportunities, a rigorous framework tailored to Africa’s specific context is essential to achieve a balance between competing dimensions of ‘value’ and ‘affordability’, and to link these dimensions to procurement, project implementation, evaluation, and monitoring. Whilst effort will be made to ‘afford’ something that is perceived to have ‘value’, a major difficulty is that ‘value’ is relative. An African eHI appraisal framework will need to accommodate a broad understanding of value.

There are numerous approaches to health economic impact assessment. [1-6] Some extend beyond economic aspects to deal with broader societal impact, often referred to as socio-economic impact, [7,8] which includes the Health Impact Assessment approach. [9,10] Few are specific to eHealth, with the European eHealth IMPACT study being a notable exception, [11] and none could be found that dealt explicitly with Africa’s specific context, especially its very constrained finances and limited eHealth capacity.

This paper explores the above issues and dilemmas and offers a basis for developing a framework to help African countries and organisations analyse eHealth’s broad impact for their citizens and other stakeholders. The final output will be Africa’s eHI appraisal framework. To be useful, it must be a practical tool, accessible to a range of users, some of whom will lack ready access to all of the desired data, and the economic and statistical knowledge and expertise needed to use most existing methodologies. Through being accessible, the eHI appraisal framework will help decision makers to navigate complex issues related to eHealth’s costs and benefits, and to take decisions that improve the likelihood of achieving net benefits over time for stakeholders, namely people receiving healthcare, providers of that care, and all people wanting to remain healthy.

**Methods**
A desktop literature review was conducted to explore health and economics aspects of African countries' eHealth contexts and the kind of eHealth economic appraisal framework that would be appropriate to help these countries appraise and implement successful eHealth initiatives.

**Results**

**The African Health Context**

Africa is home to 1.2 billion people and the population is forecast to double by 2050 [12]. UNICEF forecasts that there will be twice as many children in Africa in 15 years' time [13] and the World Health Organization (WHO) shows that, alongside Africa's infectious disease epidemics and maternal and child health threats, the incidence of non-communicable disease is increasing too. [14]

Health needs in the African region are greater than those on other continents across most indicators. [15] Comparing WHO regional health statistics for 2015, the African Region had the lowest healthy life expectancy at birth (52.3 years), highest maternal mortality ratio (542 per 100,000 live births), lowest proportion of births attended by skilled health personnel (53%), highest under-five mortality rate (79 per 1,000 live births) almost double the global rate [16] and highest neonatal mortality rate (28 per 1,000 live births). Immunisation coverage was lowest.

Africa remained the most severely affected by HIV, with 4.4% of adults aged 15–49 years living with the disease [17] and new HIV infections among adults 15–49 years old were highest in the Africa region (2.72 per 1,000 uninfected population). The Tuberculosis (TB) case fatality rate varied from under 5% in some countries to more than 20% in most countries in the WHO African Region, where TB incidence was highest (254 per 100,000 population) in 2016. [18] The Malaria incidence (244.9 per 1,000 population at risk) was highest in the WHO African Region as was the burden of Malaria deaths. Approximately 90% of all deaths occurred in this region with children under five years of age worst affected. [19] Although food insecurity, potable water, and sanitation issues exist in parts of Asia and Latin America, the greatest food insecurity and least access to water and sanitation are found in Africa, threatening health. [20,21]

Compounding these findings are challenges to health governance and payment of workers, which also influence overall health. [22] The WHO African Region also had the highest road traffic mortality rate (26.6 per 100,000 population) and highest mortality rates due to hygiene issues and poisoning. Furthermore, the skilled health professional density is lowest in Africa (14.1 per 10 000 population) and health regulation scores are also lowest. [19]

Amongst developing regions of the world, health and healthcare are most severely challenged in Africa.

**The African eHealth Context**

eHealth initiatives have an increasing role in helping to address the identified health challenges. The WHO reports that “it has become increasingly clear that Universal Health Coverage (UHC) cannot be achieved without the support of eHealth” [23] and there’s a suggestion that “access to broadband is, or soon will become, a social determinant of health”. [24]
As the health landscape changes, eHealth opportunities expand too. Decisions on what to invest in, and how to do it, are becoming more complex. In the mid to late 20th Century, telemedicine initiatives were tested in many specialties. By the 1990's electronic records, including Electronic Health Records (EHRs), were seen as the solution, now they're seen as not enough. Informatics was the next solution and now we see that more analytics are required too. Arising from the birth of mobile technologies came mHealth. Now, social media, artificial intelligence, health analytics, and the Internet of things each offer new and challenging opportunities.

eHealth investment needs to balance appropriate proportions of a range of different types of eHealth that provide health information and services that are interoperable, integrated, adequately used, can be interrogated, and are scalable and sustainable. It must also consider pragmatic factors such as eHealth strategies, architecture, interoperability, information and communications technology capacity, health human resources, security, functionality, usability, costs, benefits, affordability and risks. Decision makers must collectively consider this myriad of factors.

Some African countries are embracing eHealth [25,26] with a number of National eHealth strategies in place. [27-32] However, uptake has not always sustained, or at a large scale. [33] [34-37] As shifting health challenges combine with maturing eHealth opportunities, consideration of different solutions, in different proportions, in different settings is required. This constantly changes the nature of eHealth investment decisions. An African eHI appraisal framework must reflect and resolve these dynamics.

Key eHI Appraisal Terms and Concepts

The complexity of health, healthcare and eHealth choices is further compounded by impact appraisal terminology and concepts that are unfamiliar to many eHealth stakeholders, decision makers and implementers. Experts also, at times, disagree.

Definitions for key terms provide essential perspective and clarity in order to discuss, build and use an eHI appraisal framework. The terms impact, appraisal, socio-economic, financial, Value for Money (VFM), affordability and risk, and their inter-relations, are addressed below.

- **Impact** is the extent to which eHealth investment achieves its objectives, including resources, costs, benefits, net benefits financing and timescales.
- **Appraisal** is a generic term, simply meaning the process of arriving at a judgment about something. For convenience, the timing of an appraisal can be used to distinguish two types:
  - **Prospective**: An appraisal performed in advance of implementation to estimate the probability that the initiative will deliver on its promise, that allows options to be weighed to identify the best choice.
  - **Retrospective**: An appraisal performed after implementation of an initiative that helps to make a judgement on the extent to which the initiative succeeded in delivering on its promise.

An eHI evaluation can be part of the broad health systems monitoring and evaluation envisaged by WHO, [38] to measure “What results are achieved in terms of better health outputs, outcomes and impact, and at what cost.”
Socio-economic change is a measure of VFM of eHealth that is part of Cost Benefit Analysis (CBA) methodology.

The financial perspective is the affordability of an eHealth investment, measured by capital and operational cash flows and income and expenditure. Fisher’s Separation Theorem [39] says that investment should maximise VFM, regardless of how it is financed. An example of an appraisal methodology that embeds this distinction is the Five Case Model [7,40] for good business cases. It is a proven methodology that shows how the different definitions of socio-economic and financial costs and benefits can be incorporated into effective decision taking. The other three cases are strategic, commercial and management.

VFM and affordability should be dealt with in sequence. VFM is first, then affordability. VFM is an economic concept. Affordability is a financing concept. They are interrelated. [41] The objective is to find options with the best VFM, then decide if they’re affordable and how to finance them. It avoids decisions that are affordable, but with poor VFM, so a waste of resources, and decisions with good VFM but are not affordable. With their very scarce healthcare resources, African countries must avoid both of these wasteful outcomes and seek optimal relationships between VFM and affordability. An African eHI appraisal framework must provide the VFM and affordability analysis and assessment to identify options where they can run in tandem towards these optimal links.

Risk. When risk occurs, costs can increase, benefits can reduce and timescales can lengthen. The result is often a net increase in overall costs, so a reduction in VFM over time. Business cases adjusted for risk typically show an increase in overall costs. Consequently, risk can be seen as a cost. It is an essential component of prospective assessments, but is not needed for retrospective evaluations, since the cost of how a risk played out is already embedded in the resource profiles and outcomes, and their financing. Risk has three components: the estimated cost for each item of cost and benefit and any extraneous factors, such as limited power supplier, the probability of it occurring, and a combination of the two that gives the risk exposure of an investment. It is a critical part of any investment decision, and an eHI appraisal framework for Africa has to include it.

Both prospective and retrospective appraisals are dependent on estimates and their outputs are therefore estimates too. A retrospective evaluation, combining socio-economic and financial methods, can help to reveal an estimate of the actual relationship between VFM and affordability achieved over time, and the need for any corrections. It provides valuable information about the relationships between costs, benefits and time that can help to inform future assessments needed to support eHealth decisions. It can also test estimates for sensitivity and optimism bias.

The role of an African eHI Appraisal Framework
Extreme scarcity of resources for healthcare in developing countries is common. Competition for resources is fuelled by smaller budgets trying to address substantial service gaps such as expanding populations, health worker shortfalls, [42] limited infrastructure and expensive connectivity, and higher and changing disease burdens. [43] eHealth may assist with some of these issues, but needs financing too. As it competes with other health needs it becomes simply one of several options, which makes it an opportunity cost.
Decisions to invest in eHealth need to be taken with considerable care, and must be economically sound, affordable, and evidence-based. This requires integrated economic and financial models. Sustainability, especially affordability, is critical for lower and middle-income countries and the opportunity cost consequences of a failure are much too large. This constraint emphasises the need for decisions that result in achievable, sustainable, affordable, reliable benefits that support approaches to enhance citizens’ health and make healthcare stronger.

The eHI appraisal framework’s role is to help select those eHealth options worth considering from a wider range of choices, by demonstrating that the eHealth projects chosen offer more VFM than competing projects such as other eHealth initiatives, more conventional healthcare investment such as more drugs, more doctors, nurses and pharmacists and more facilities, or various combinations of these. The comparison may be between a conventional healthcare initiative without eHealth and conventional healthcare with eHealth support. Of equal importance is showing that where an eHealth initiative does not offer more VFM than without the eHealth, it should not proceed.

Despite considerable optimism about the potential value of eHealth and its components, such as telemedicine, few reports have appraised aspects such as VFM and affordability. Experience in the developing world shows that identifying and quantifying benefits within the implementation communities is necessary for the integration and sustainability of telemedicine and cautions about few studies having addressed this. Quantifying value is probably more useful than optimism over potential value.

A common feature of eHealth is that its relationship with patients’ outcomes seldom shows a direct cause and effect. Many other aspects are also changing and developing the environment and context, confounding the relationship, such as: hiring more healthcare professionals; improving healthcare professionals’ training opportunities, knowledge, and skills; strengthening protocols and access to care guidelines; more effective collaboration between professionals; and the availability of informal carers. Health and health systems are recognised as being Complex Adaptive Systems, and have been described using Complex Systems Analysis. eHealth adds further complexity, which calls for a methodology that can deal with this. CBA provides this, and is the foundation of the eHI framework.

There are many variables, such as the way that health workers use or don’t use available information, the range of healthcare resources and care models available, and the range of possible eHealth applications and technologies. These add to the difficulty of identifying which actions or activities cause a change in patient outcomes. For example, EHRs have components of medical records and administrative systems. If an oncologist using an EHR achieves good clinical outcomes for a particular patient cohort, it may be difficult to be explicit about the extent to which the availability of accurate information or good eHealth contributed to the clinical improvements, compared with the role of sound, evidence-based protocols and effective care models of an experienced and diligent professional, unless examined under randomised control study conditions.
For Africa, good eHealth may result in greater demand for and utilisation of healthcare as more needs are identified and met. This is likely to create an affordability challenge for patients and citizens that needs including in eHealth appraisals.

Discussion

What an African eHealth Impact Framework might look like

The unique needs and challenges of African countries’ health systems require a bespoke eHealth impact framework that addresses VFM and affordability and helps to direct eHealth investment decisions and subsequent implementations. African countries need a simple and generic appraisal methodology that can be used to analyse eHealth initiatives across a wide range of settings. It has been partly done in Europe, [50] though it is unlikely to transfer directly to Africa.

An African appraisal methodology needs to fit emerging African health priorities and eHealth issues, such as more extensive use of integrated mHealth, and needs to address unique local challenges, such as scarcity of health workers, that change the eHI appraisal framework’s focus and make its links to affordability more critical. The eHI methodology presented here offers a basis to set up an initial African framework, which can be further developed. As a start-up methodology, it will provide a foundation for subsequent development based on experiences and findings from appraisals.

The expanding health and eHealth contexts make eHealth investment decisions complex. A structured way to appraise them is essential. For the African context it needs to address at least three main components:

1. Finding an optimal relationship between VFM and affordability, therefore incorporating both socio-economic and financial models
2. Supporting prospective and retrospective appraisal

Despite the complexity, analysis of value has traditionally focussed on metrics of patient outcomes, safety and return on investment. eHI needs to go beyond this to include socio-economic factors such as measures of satisfaction experienced by patients and providers, [46] increased reach of the healthcare system due to eHealth, estimation of the indirect effects on patient outcomes, and the impact on legal and administrative requirements of health information.

eHI studies can deal with these needs and challenges by identifying them and separating out each one’s related eHealth costs and benefits. Guidance and practical skills on how exactly to do this, however, is lacking. Experience is beginning to emerge from international frameworks, [51] yet these rely heavily on data, economic expertise, and statistical knowledge, all of which are extremely limited in African countries, and rarely include the financial and affordability aspects of eHealth investment. Their absence contributes to the lack of appraisal as well as the paucity of attempts to define and test suitable appraisal methods and approaches for Africa.

Some guidance is available through the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement, which provides insight on what should be covered in a good appraisal. [52] CHEERS was developed for health economics. The
application of health economics “reflects a universal desire to obtain maximum value for money by ensuring not just the clinical effectiveness, but also the cost-effectiveness of healthcare provision.” [53] eHI appraisals support this by providing a method to explore the options that exist, or where to start, describe financing requirements for affordability planning, and clarify where high-level economic assessment skills may be required. The eHI appraisal information is vital for planning in resource constrained settings.

An eHI method for Africa will appraise eHealth’s impact on people, their health and the healthcare system. It may utilise one or more of a variety of methodologies depending on available data, experience and expertise. Socio-economic methods are preferred, based on CBA. Cost Effectiveness Analysis (CEA), Cost Utility Analysis (CUA) and Cost Consequence Analysis (CCA) are common alternatives. [54] Each has advantages, limitations and challenges. Some appraisals adapt common methods to help address data shortages or to introduce social variables that are not easily standardised.

A generic eHI appraisal, with a direct link to the supporting financial and affordability aspects, is appropriate for many Africa countries’ eHealth initiatives.

Because eHI includes the effect on people, it is important that the implications for them are included. This extends the economic dimensions into socio-economics, and when this is linked to the financial perspectives, it can enable decision makers to seek an optimal relationship between the two. The socio-economic measure is still VFM, referred to as socio-economic return providing a wider view of costs and benefits, across broader stakeholders. The financial measure remains affordability.

**Towards Developing an African eHI Appraisal Framework**

Development of the framework needs Africa’s specific requirements to be matched with appropriate economic and financial methodologies, and these assembled in a practical manner that allows modular, scalable application. This development process will:

- Explore eHealth’s role in African health systems strengthening
- Clarify the case for eHI appraisal in African countries
- Identify good practice frameworks for eHI and assess them against African countries’ needs
- Identify and describe knowledge and perspectives that need to be added to the good practice frameworks to assemble an appropriate African eHI appraisal framework
- Create a generic template for users to adapt.

While this work is underway, African countries can begin building eHI capacity and experience, to contribute to the framework development and prepare to use it, by:

- Adopting proven techniques, such as the Five Case Model [7] for business cases
- Beginning to use appraisal techniques while developing skills and understanding
- Incorporating socio-economic and affordability appraisal reports into engagement and decision taking, particularly with eHealth planning, procurement and monitoring and evaluation, and including them in eHealth Strategy developments. [55]
Conclusion

eHealth investments are opportunity costs, competing with many other healthcare priorities. In order to make sound choices about resource commitments, an appropriate, structured eHI appraisal framework is needed that includes social, economic and financial costs and benefits. Such appraisals must become integral to operational and executive decision-making and a routine part of eHealth business cases. They should be the foundation of both planning and monitoring and evaluation of eHealth initiatives throughout their life cycles, from conceptualisation and financing, through implementation and on to obsolescence and exit, or back into reinvestment.

For lower and middle-income countries, such as those in Africa, where resource limitations are severe, the framework should allow for a basic start-up, and progressive application, as skills, experience and resources expand. This will promote participation by eHealth’s varied stakeholder types, utilising appropriate appraisal techniques, within a well-structured, broad framework, to support easy entry to begin rudimentary assessments, and allow progress to more sophisticated analysis as evaluators’ knowledge of, and expertise in using available methodologies expands. Developing this practical African eHI appraisal framework is the goal of current research and will be the subject of forthcoming publications.

Conflicts of Interest
None.

Abbreviations
CBA: cost benefit analysis
CHEERS: consolidated health economic evaluation reporting standards
eHI: eHealth impact
EHR: electronic health record
VFM: value for money
WHO: World Health Organization

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