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Background paper

eHealth: use of information and communication technology in health

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Executive Summary

Health is an information- and knowledge-intensive sector that requires extensive use of information and communication technologies (ICTs). The use of ICTs in health is known as eHealth, an umbrella term that covers a variety of concepts such as health and medical informatics, digital health, telehealth, etc. This background paper aims to review the main issues surrounding eHealth implementation in an African context.

In Africa, the health situation is such that the continent is still lagging behind schedule in terms of achieving the Millennium Development Goals (MDGs) by 2015. Africa suffers from a multiplicity of communicable diseases, of which HIV/AIDS, malaria and tuberculosis take the highest toll. Health systems in Africa suffer from fragmentation, shortages of trained human resources, weak information systems, lack of good governance and financial constraints.

Although the ICT infrastructure in Africa has made substantial progress in recent years, as shown by an increase in Internet penetration rates, mobile telephone network coverage and the availability of personal computers (PCs), universal coverage in these areas is still far from having been attained. For eHealth to realize its full potential, it has to become an integral part of national health plans and be used to strengthen health systems through data collection, information management and access to research and evidence. Health informatics has many areas of application, including resource management, epidemiological surveillance, computer-based medical record-keeping, access to health literature and information services, knowledge-based services, geographic information systems (GIS), and eHealth and telemedicine.

Achieving the MDGs in Africa is a major challenge, but many believe proper use of ICTs in health can help meet it by improving quality and efficiency in primary care and by enabling people in remote and underserved areas to access services and expertise otherwise unavailable to them. It can also improve access to training opportunities for the health workforce at all levels. Policy and strategy development is very much needed as the only way to bring all stakeholders together in a coordinated and synchronized effort. A national ICT strategy can provide the necessary legislative framework and the national information backbone required for the establishment of a common technical infrastructure, interoperability and standardization protocols, access to information across boundaries and health information for citizens.

Stakeholders in strategy development and implementation may include governmental and nongovernmental organizations (NGOs), the private sector, the donor community and civil society. Standardization and interoperability are among the most important ways to safeguard investments in eHealth and make them sustainable. eHealth solutions that do not follow international standards and that are not interoperable cost more, tend to be short-lived and fail to meet national challenges. Interoperability has to be assured at both the technical and linguistic levels.

The quality of the health information posted on the Internet has been scrutinized by all those who are interested in web site content and its role in health and medical education, health promotion, research and development. Quality control criteria and codes of ethics have been developed for website developers and users. Many eHealth projects are initiated as demonstration or pilot projects with a lifespan of a few years. Other activities are initiated with the good intention of sustaining them for as long as necessary. However, many of these projects are aborted as soon as funds run out, staff leave or interest declines, or when even a minor legal issue arises.

The evaluation of eHealth projects and initiatives is a critical issue for decision-makers, planners and funders. There are currently no standard evaluation methodologies or indicators for evaluating eHealth projects. Many such projects are still evaluated as pilot or demonstration projects conducted in a controlled environment and with a limited scope. There is a definite need to develop criteria for evaluation and indicators.

The economic value of eHealth projects and their impact on the health situation likewise remains an issue. There is little evidence available to show that eHealth solutions are cost-effective, provide a high return on investment and help improve health outcomes.

Evaluation, cost-effectiveness and financing of eHealth have together served to boost public-private partnerships in eHealth. Financing eHealth requires collaboration and coordination between multiple partners from the private sector (health and technology) and the public sector represented by the government. Partnerships should be guided by properly thought-through criteria based on the specific need or situation and should be clear as to purpose, objectives, roles, responsibilities and risk assessment. The availability of trained personnel to manage eHealth projects has been identified as one factor of success. The development and provision of health informatics training programmes at the national level will ensure that health-care professionals have an in-depth understanding of the role of ICTs in health and that qualified personnel are available to manage and operate eHealth services.

In conclusion, eHealth has enormous potential to help strengthen health systems in Africa and achieve the MDGs. eHealth applications and services range from supporting public health surveillance to personal health, health education and e-learning. For eHealth to be successful it has to be incorporated into national health plans and health systems. Among the issues to be considered in the consultation are national policy and strategy development, standardization and interoperability of applications and systems, the quality of health information on the Internet, the sustainability of eHealth initiatives, evaluation of eHealth projects and initiatives, the economic value of eHealth and its impact on health, public-private partnerships in eHealth and health informatics training.

1. Introduction

Health is an information- and knowledge-intensive sector. Understanding health problems and proposing solutions for better outcomes require regular and systematic data collection, the generation of information for and the use of evidence in all health-related activities. The complexity and volume of the body of knowledge that has accumulated in the health and biomedical fields make it almost impossible to manage without the tools for data processing, storage and communication. For a health sector to be effective and responsive to people's needs, it has to be evidence-based. Evidence can only be generated if information resources are properly managed. For Africa to achieve its health goals, it has to fully utilize the power of knowledge, ensuring that the right information reaches the right individual, at the right time and in the right place. Much has been said about the role of ICTs in health. The technical literature and case studies provide a rich account of how, when, where and to what purpose eHealth has been used and how cost-effective it has been. The benefits of eHealth include reducing the cost of health care and increasing efficiency through better retention and retrieval of health records, better management of data on public health, better management of chronic diseases, shared health staffing, knowledge networking and learning, reduced travel times, improved access to and quality of health information, improved registries and fewer or shorter hospital stays.

The aim of this background paper is to present the main strategic issues relating to eHealth in Africa for use at the ECOSOC regional meeting. The different panels and speakers will cover the issues in greater detail, citing examples from Africa and other parts of the world, describing lessons learnt and the way forward.

2. eHealth: a definition

The term eHealth has been in use for less than 10 years. A number of terms have been employed to mean different or similar things. These include health informatics, medical informatics, telemedicine (and all other medical specialties prefixed with tele), public health informatics and bioinformatics. Digital health has emerged as a potential concept that simply implies moving from "analog" to digital health and medical services. eHealth is used here to mean all forms of ICTs, even those that are not digital, such as radio and television. Interestingly, MeSH (US National Library of Medicine Medical Subject Headings) has an entry for medical informatics, but not for any of the other terms. No attempt will be made here to discuss or cover these definitions.

In a systematic review of published definitions of eHealth, Oh et al. [1] provided a list of 51 definitions that appeared in the literature between 1999 and 2004. They concluded that "[t]he widespread use of the term eHealth suggests that it is an important concept, and that there is a tacit understanding of its meaning".

Among the most frequently cited definitions is Eysenbach's [2]: "e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related

technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology". Eysenbach listed 10 other "e's" implicit in eHealth. These are:

1. To increase Efficiency in health care;
2. Enhancing quality of care;
3. Evidence-based;
4. Empowerment of consumers and patients;
5. Encouragement of a new relationship between patient and health professional;
6. Education through online sources;
7. Enabling information exchange and communication in a standardized way between health establishments;
8. Extending the scope of health care beyond its conventional boundaries;
9. Ethical considerations;
10. Equity, as all measures need to be taken to bring benefits to all people without exception.

For the purpose of this paper, the definition provided by WHO [3] will be used to indicate what the concept covers and how it is understood by the Organization: "eHealth is the use, in the health sector, of digital data - transmitted, stored and retrieved electronically- in support of health care, both at the local site and at a distance."

eHealth applications vary widely and can be used to:

- store, process and transmit patient information;
- manage the diverse clinical, administrative and financial information generated in hospitals;
- provide mechanisms for diagnostics and treatment between health professionals separated by distance;
- build capacity by offering health sciences training and continuing education courses online to students and health professionals;
- take advantage of the growing number of mobile devices to offer innovative approaches to health care;
- make highly complex biomedical research achievable through distributed computing or Grids.

3. eHealth in the African context

3.1 Health situation in Africa

The African continent comprises 53 Member States covered by two WHO Regional Offices: the Regional Office for Africa (AFRO) in Brazzaville (46 Member States) and the Regional Office for the Eastern Mediterranean (7 Member States). Health problems

are more acute in sub-Saharan Africa and in countries such as Djibouti, Somalia and Sudan.

The *Strategic Orientations for WHO Action in the African Region, 2005-2009* provide a situation analysis indicating that the African Region is still dominated by a high prevalence of communicable diseases and high maternal and infant mortality in the context of weak and fragmented health systems. Key health determinants such as the environment, access to clean water, food safety, nutrition, behavioural risk factors, illiteracy and extreme poverty continue to compromise health development efforts. A combination of these factors has resulted in a decline or stagnation in key health indicators. Average life expectancy at birth is now 47 years. In 2003, an estimated 3.2 million people become newly infected with HIV while another 2.3 million died of AIDS-related diseases. Of the 4.4 million people living with HIV/AIDS in the Region, only 8 per cent have access to antiretrovirals. Africa also bears 66 per cent of the global AIDS burden and 60 per cent of the global malaria burden. About 3.5 per cent of adults and 1.8 per cent of under-fives use insecticide-treated nets to prevent malaria. Only 13 per cent of countries are fully implementing intermittent preventive treatment for pregnant women. The prevalence of tuberculosis (TB) is 492 cases per 100,000 inhabitants, or 27 per cent of the global disease burden. The TB case-detection and treatment success rates are 50 per cent and 70 per cent, respectively. The average maternal mortality ratio is 1,000 per 100,000 live births; the average infant mortality rate is about 57 per 1,000 live births. The malnutrition rate among children is 15 per cent. Malaria, tuberculosis, HIV/AIDS, obstetrical complications, anaemia, road traffic accidents and cardiovascular diseases constitute over 90 per cent of the Region's disease burden. Most national budget allocations are used to cover curative services and the recurrent costs of health facilities and services; very few resources are deployed for prevention, promotion and rehabilitation. In general, the coverage of essential health services is low, the main problems being availability and accessibility. This has resulted in considerable inequalities in health-care provision and access.

In addition to the high disease burden, Member States are faced with high levels of poverty and slow economic growth. The health budget averages 8 per cent of the total national budget, although African heads of State have committed to 15 per cent. Limited financial and human resources as well as recurrent natural and man-made disasters have resulted in weak health system performance and inconsistent application of health policies. Safe water, a healthy environment, good governance and economic growth tend to be inadequately addressed as social determinants of health. Intersectoral coordination is weak within countries and between external partners. [4]

The health of the people: the African regional health report [5] recognizes that the African Region lags behind others in terms of human development. This is largely attributable to the Region's immense burden of infectious diseases, particularly HIV/AIDS, tuberculosis and malaria.

3.2 Health systems in Africa

A health system is the sum total of all the organizations, institutions and resources whose primary purpose is to improve health. A health system needs staff, funds, information, supplies, transport, communications and overall guidance and direction. It also needs to provide services that are responsive and financially fair, while treating people decently.[6]

The health of the people: the African regional health report [7] indicates that one of Africa's biggest public health challenges is to build and reinforce its weak and dysfunctional health systems so that they are capable of delivering essential health care to the population. It identifies several key elements required for health systems to function properly (adequate numbers of skilled health workers, basic infrastructure and equipment, essential medicines and supplies and health financing systems) and underscores the importance of establishing effective health information systems, including registration, to measure the scale of a given health problem and gauge the appropriate response. Such a system should provide basic, timely information on a number of points: how many people die and of what causes; the chief causes of disease; who is treating patients; how many people can access care; how much it costs; treatment outcomes; shifting gaps in coverage. Patient registration, medical records and appointment systems not only make it possible to manage patients, they also enable health authorities to collect data that can be collated and used to set priorities.

The report concludes that health systems are the key to better health in Africa. Countries need to build and reinforce their health systems as a platform for providing a broad range of essential health care services to their people.

3.3 Information and communication technology in Africa

At the end of 2008 Africa had an estimated 975,330,899 inhabitants, or about 14.5 per cent of the world's population. The latest data estimate the number of Internet users on the continent to be 54,171,500, a penetration rate of 5.6 per cent in Africa and of 3.4 per cent worldwide. Internet access in Africa grew at a rate of 1.1 per cent in 2007/08, compared to 328.5 per cent worldwide. The top 10 African countries in terms of Internet users are Egypt, Nigeria, Morocco, South Africa, Algeria, Sudan, Kenya, Tunisia, Zimbabwe and Ghana. The highest Internet penetration rate was in the Seychelles (37%) and the lowest in Sierra Leone (0.2%).[8]

Other reports indicate that by early 2006, the overall Internet penetration rate in Africa was around 4 per cent (up from 2.6% a year earlier), with the highest rate recorded in Reunion and the Seychelles (over 20%), followed by Mauritius (15%) and Morocco (12%).[9] It is estimated that each Internet-connected computer in Africa supports on average 3 to 4 users.[10] Access to the Internet has a demonstrated impact on a country’s ability to exchange and transfer data and on its people's ability to generate, access, use and share knowledge.

The total number of PCs in Africa was estimated at 10 million units in 2003, with a penetration rate of 1.2 per cent.[11] Africa is said to be one of the fastest growing markets for information technology in the world, with an annual growth rate of more than 14 per cent.[12]

At the end of 2006, there were more than 188 million mobile phone subscribers in Africa — approximately 20 percent of the African population. In early 2006, 95 percent of all mobile subscriptions in Africa were pre-paid. The lack of fixed network infrastructure, the availability of low-denomination pre-paid vouchers, and GSM technology are driving the growth of the African mobile market.[13]

A study by the International Telecommunication Union (ITU) [14] concluded that, whether fixed, mobile or Internet, Africa's ICT future is definitely a wireless one. In the absence of fixed-line networks and of a sufficient number of PCs, mobile phones are likely to be increasingly used as a means of accessing the Internet, and in the immediate future it is mobile technologies such as General Packet Radio Service (GPRS), combined with wireless technologies such as WiFi, that are likely to drive the mobile Internet market. With a number of the Region's mobile networks ready for GPRS, it is only a matter of time before operators keen to address stagnant levels of ARPU (Average Revenue per User) begin to push GPRS as a means of accessing the Internet.

4. Mainstreaming eHealth: integrating eHealth into national health plans

Mainstreaming eHealth into health systems faces many challenges relating to human resources, infrastructure, governance, resourcing and health systems. Kirigia et al. [15] states that while eHealth offers unprecedented opportunities for improving equity in access to health, the transition to eHealth faces a number of challenges in the African Region:

1. high adult illiteracy rates
2. low enrolment rates in primary and secondary schools and in tertiary institutions
3. lack of ICT technical expertise
4. low per capita incomes
5. lack of ICT infrastructure and limited Internet connectivity.

These challenges need to be addressed at all levels: by the international community, national governments, NGOs, civil society, the private sector, local authorities, individual communities and individuals. Unless a coordinated and concerted effort is made to tackle them, eHealth will continue to lag behind other possibilities as a potential contributor to better health in Africa.

Commenting on the failure of the G8 meeting in 2007 to focus on ICTs in Africa, Heeks [16] believes that even when African governments can pay for access, local ICT users find themselves hampered at all three layers of ICT infrastructure:

- ICT networks lack the Internet exchange points required for open connectivity;

- ICT applications rely heavily on proprietary applications, leaving the promise of free and open-source software underexploited;
- ICT content relies heavily on foreign – often foreign language – data, preventing the open creation of relevant local data content.

Among the many challenges facing eHealth uptake in Africa is the failure to integrate eHealth activities into national health plans. The fragmentation of myriad vertical health programmes coupled with weak health systems has left the continent with eHealth activities that are deployed everywhere but effective nowhere.

4.1 eHealth and health systems

Shortcomings in health systems have translated into weaknesses in eHealth implementation. Policy development, planning, programme implementation, monitoring and evaluation require extensive use of information and knowledge. Health care being a knowledge-intensive sector, data must be collected at all levels, aggregated, analysed and transformed into meaningful information that can be used to manage the sector properly.

When it comes to overall progress in health, according to Wang J et al. [17], quoted in *The World Health Report 1999* [18], the generation and utilization of knowledge – that is, scientific and technical progress – accounted for almost half of the reduction in mortality between 1960 and 1990 in a sample of 115 low- and middle-income countries, while income growth accounted for less than 20 per cent and increases in the educational level of adult females less than 40 per cent. Such estimates encapsulate the progress made in developing and applying many kinds of measures against a large number of diseases. Prominent among these are antimalarial and immunization programmes, and the growing use of antibiotics to treat respiratory and other infectious diseases. Since it is the health system that develops and applies these measures, two kinds of evidence, one detailed and the other aggregated, indicate clearly that health systems not only can but do make a large difference to health.

The report pointed to the generation and utilization of new knowledge as the dominant force underlying the 20th century revolution in health. Health systems therefore have a responsibility to provide for the generation of new knowledge.

The link between knowledge generation, sharing, utilization and application, on the one hand, and ICTs, on the other, is the ability to collect, store, process, manipulate, present, share and disseminate information in ways and quantities that have never been possible before. The move to a knowledge-based economy and information society can only be realized through proper use of ICTs.

The Economic and Social Commission for Asia and the Pacific [19] concluded that eHealth had had a number of positive impacts on health systems. It had:

- improved cost-effectiveness by making the most efficient use of available financial resources, minimizing the costs incurred in health-care delivery and meeting rising expectations for health care;
- improved the quality and safety of treatments through the provision of appropriate and timely information leading to enhanced adherence to therapies, target consultation and monitoring;
- provided relief to strained health-care systems in disaster situations;
- contributed to home care in societies with increased populations of older persons;
- strengthened health-care delivery systems in isolated and remote areas through mobile units, helping to address shortages of health personnel in those areas;
- enhanced educational opportunities for health personnel, administrative officials, policy-makers, politicians and the general public;
- stimulated technology absorption and enabled the effective functioning of public health systems through the use of ICTs.

4.2 Health informatics and public health

Public health informatics (PHI) is defined as "the systematic application of information and computer science and technology to public health practice, research, and learning".[20] Yasnoff et al. (2000) [21] add that it is important to note that PHI involves more than just automating existing activities. It also involves the conceptualization, design, development, deployment, refinement, maintenance and evaluation of communication, surveillance and information systems relevant to public health. They suggest four principles that should define, guide and provide the context for the types of activities and challenges that comprise PHI. According to them, PHI should primarily:

1. focus on applications of information science and technology that promote the *health of the population rather than the individual patient;*
2. focus on applications of information science and technology that *prevent* disease and injury by altering the conditions or the environment that put populations of individuals at risk;
3. explore the potential for prevention *at all vulnerable points in the causal chains* leading to disease, injury or disability; applications should not be restricted to particular social, behavioural or environmental contexts;
4. reflect the *governmental context* in which public health is practiced. Much of public health operates through government agencies that require direct responsiveness to legislative, regulatory and policy directives, careful balancing of competing priorities, and open disclosure of all activities.

Using informatics to manage information has quantitative, qualitative and strategic benefits. Computerized medical data can take different forms depending on the needs and method of presentation, but the most important thing is for the data to be complete, reliable and accurate. The role of health informatics with regard to health-care workers encompasses practical needs, training needs and lifelong education. The areas of application of health informatics and their inherent benefits include management,

epidemiological surveillance, computer-based medical records, access to literature and information services, knowledge-based services, GIS and eHealth and telemedicine.

4.3 eHealth and the MDGs

The MDGs represent a set of goals and targets to be achieved by countries by 2015. Many countries are on track for achieving some of the MDGs. In recognition of the tremendous value of ICTs to health, among other fields, Target 18 of Goal 8 (Develop a global partnership for development) is to: "[i]n cooperation with the private sector, make available the benefits of new technologies, especially information and communications". In recent years, adoption of these technologies has grown rapidly in Africa as demonstrated by the figures in section 3.3 above on Internet access, mobile communications and PCs. While further growth remains a challenge requiring support, the current infrastructure presents tremendous opportunities. One such opportunity is the application of ICTs to health, or eHealth. eHealth can encompass a wide variety of different applications that support the MDGs through more effective management of health information and access to knowledge:

- point-of-care support (e.g. telemedicine, clinical decision support);
- patient support and information (e.g. SMS reminders for drug compliance, online health information);
- electronic health records (EHR), electronic medical records and patient health records that improve patient safety, efficiency and rational use of medicines, etc;
- eLearning and continued education for the health workforce;
- access to knowledge and research (electronic publications, web sites, databases, etc);
- disease and intervention surveillance, including statistical databases, trend analysis and health mapping;
- faster and more efficient orders and results (e.g. lab work).

The World Health Report 2008 [22] recognized the role of ICTs in improving access, quality and efficiency in primary care as they enable people in remote and underserved areas to have access to services and expertise otherwise unavailable to them, especially in countries with uneven distribution or chronic shortages of physicians, nurses and health technicians or where access to facilities and expert advice requires travel over long distances.

5. Policy and strategy development

5.1 Why adopt a national eHealth strategy?

eHealth projects and applications require the coordinated involvement of at least two sectors: health and ICTs. Each has its own national strategy and plans. In some cases these are part of a national development plan, but in most cases they are not aligned. This leaves the door open for duplication of effort, lack of integrated solutions, and mismatching between people's needs and sector responses. The national eHealth strategy

is the only platform that will ensure the different stakeholders are brought together in a coordinated manner. Its development requires input and, more importantly, commitment from all partners and stakeholders. Those involved in the strategy's development and implementation are expected to take up a common position on all issues of strategic importance pertaining to the role of ICTs in improving and possibly changing the health-care system and to recognize the need to develop joint approaches for resolving issues related to use of ICTs in health at the national level. A national eHealth strategy includes the common threads that bind national health strategies with national ICT strategies. It will require compliance and the alignment of subnational and local plans. This is the only way of guaranteeing that national needs are met through synergic action, that scarce resources are managed in the most rational manner and that eHealth solutions are interoperable and integrated (if needed).

5.2 What does a national eHealth strategy cover?

As stated, eHealth is the use of ICTs in the health sector. It requires full coordination between the two sectors and all the other related sectors in government, the private sector and civil society.

At its 58th Session in May 2005 [23], the World Health Assembly called on all countries to develop long-term eHealth strategies and policies to improve health worldwide. For eHealth solutions to be efficient, cost-effective, coordinated, needs-based, measurable, scalable and dynamic, the eHealth strategy has to cover a number of specific areas.

1. Legislative framework: laws and regulations have to allow for the use of ICTs in health in areas such as data protection, personal identity management, confidentiality of health information, electronic signature and access to personal files.
2. National information structure: communication of data and information at national level requires a standardized format, agreed terminology and a structure that makes information retrieval, utilization and protection a manageable task.
3. Creating a common technical infrastructure: the availability of reliable, affordable and appropriate ICT infrastructure at the national level is a prerequisite for successful eHealth. Responsibility for making that infrastructure available lies with other national bodies and requires high-level strategic planning.
4. Interoperability and standardization: given that different information technology (IT) systems and applications will be or have been deployed, a national strategic plan must be developed to ensure that these systems can and will communicate and exchange data accurately, effectively, securely and consistently and that their content is secured and accessed only by authorized persons.
5. Access to information across boundaries: organizational and geographic boundaries should not limit access to health data and information. Access is managed through agreed protocols for data protection, privacy and authenticity. The national eHealth legislative framework should provide the basis for protecting data, users and citizens from misuse.
6. Health information for citizens: access to information for health promotion, health education, health literacy and awareness requires consideration of legal and

ethical aspects such as the quality and credibility of information, whether or not it is evidence-based, the source, conflicts of interest and consent.

5.3 Who are the stakeholders in the strategy's development and implementation?

eHealth involves a number of national bodies that contribute to planning, funding, implementation, monitoring and evaluation. They include:

1. the ministry of health
2. the ministry of information and communication technology
3. legislative bodies and other legal organizations
4. academic and research institutions
5. the private sector
    - private health-care providers
    - ICT companies
    - consultants and experts
6. NGOs
    - civil society organizations
    - the donor community
    - philanthropists, foundations and trusts
7. international organizations
    - United Nations agencies
    - the European Commission
    - international and regional development banks.

6. Standardization and interoperability

The International Organization for Standardization (ISO) [24] defines a standard as a document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

International standards [25] and their use in technical regulations on products, production methods and services play an important role in sustainable development and trade facilitation by promoting safety, quality and technical compatibility. The benefits are significant. Standardization contributes to the basic infrastructure underpinning society, including health and the environment, while promoting sustainability and good regulatory practice.

The ubiquity of ICTs is reflected in the fact that ICT standards now represent some 12 per cent of ISO's annual production. The importance of interoperability is clearly manifested by interoperability between operators: while sending a person-to-person SMS is not a problem between operators, sending SMS data across operators is a clear limitation of this technology.

Interoperability has been defined by the Institute of Electrical and Electronic Engineers [26] as two or more parts of a system exchanging information, then using it. Interoperability is the ability to communicate and exchange data accurately, effectively, securely and consistently with different IT systems, software applications and networks in various settings, and to exchange data so that the clinical or operational purpose and meaning of the data are preserved and unaltered. [27]

Interoperability standards are necessary for health information systems to share their data. They can be divided into two broad categories: syntactic standards that indicate what a piece of information is, and semantic standards that indicate what a piece of information means. Interoperability standards must also consider a multitude of critical factors beyond the specifics of the information that they encode, including, for example, security and confidentiality, bandwidth utilization and performance and cost of access. Of concern to developing countries and resource-constrained implementers and developers is free or low-cost access to existing standards.

The role of semantic interoperability standards is to preserve the meaning of the data communicated and exchanged between different systems. A lack of system interoperability hampers efforts to collect information for patient care and for programme monitoring and evaluation. It also increases the costs of system development and data use. While the need for standard semantic content in clinical systems is clear, the complexity of the clinical environment and the multitude of systems continue to be a challenge. Monitoring and evaluation systems, while containing less complex data, pose their own challenges with respect to harmonization and aggregation. Although it is possible to make systems interoperable from a purely technical perspective, doing so requires labour-intensive and expensive effort, analogous to craft work in the era of pre-industrial manufacturing. With the development of a semantic infrastructure, the process of making computer applications interoperable could be streamlined. Standard clinical concepts for patient care and monitoring and evaluation indicators need to be managed systematically to permit data to flow seamlessly between systems. An indicator registry would ensure that indicators required for international reporting could be generated from facility-level data. This, however, raises the issue of how indicators developed at the international level would be implemented in local systems consistently.

Syntactic standards are primarily concerned with the structure and transport of data. (i.e. so weight is read as weight in both systems). They do not concern themselves with the specific content of the fields, which is covered by semantic standards. While syntactic and transport standards have been in use for several decades in different sectors, there are specific business and technical issues that complicate their deployment and use in the area of health, particularly in developing countries and resource-limited settings. This section explores issues relating to the implementation of syntactic standards in health information systems that deal with individual patient records as well as aggregate data.

Free or low-cost access to existing data standards is of signal importance to developing countries and resource-constrained developers and implementers of health information systems. The current cost of participation in standards development organizations and

access to existing standards specifications can be prohibitive, forcing countries to either not implement interoperability in their systems, thereby significantly limiting their ability to share data, or to re-invent their own versions of existing standards and approaches using scarce technical resources. [28]

WHO [29] recognized the need for eHealth standardization when it established the eHealth Standardization Coordination Group (eHSCG) as a platform to promote stronger coordination among the key players in all technical areas of eHealth standardization. The group is a place for exchange of information and will work towards the creation of cooperation mechanisms to:

- identify areas where further standardization is required and identify responsibilities for such activities;
- provide guidance for implementation and case studies;
- consider the requirements for appropriate development paths for health profiles of existing standards from different sources in order to provide functional sets for key health applications;
- support activities to increase user awareness of existing standards and case studies.

7. Quality of health information on the Internet

The World Wide Web, referred to as the Web or W3, is the best known search facility on the Internet and many people use the terms synonymously. In fact, the web is only one of many information retrieval systems available via the Internet to communicate (collect, send, receive and publish/share information). Other Internet services include electronic mail or e-mail, newsgroups, bulletin boards, Telnet (remote login and retrieval of information), FTP (File Transfer Protocol), web-based meetings and teleconferencing, blogging, video and audio broadcasting and browsing.

The goal of web development was to offer a simple, consistent and intuitive interface to the vast information resources of the Internet, and its success has almost single-handedly been responsible for the exponential growth in the number of Internet users. The web provides the intuitive links that humans make between information, rather than forcing the user to think like a computer and speculate about possible file names or hidden submenus. Searching the web for health information has been made easy thanks to web technology. The web is meant for end users (professionals and consumers), rather than for expert computer specialists.

The web has enormous potential, particularly to provide and facilitate access to health information in developing countries. The technology now allows health science publishers, if they choose, to offer free or discounted access to information-poor countries that would not otherwise subscribe. This is the kind of service WHO provides through its HINARI project (Health InterNetwork Access to Research Initiative) [30], which provides access to over 5,000 medical journals to one group of countries for free and to another group at a sharply reduced price. Online journals still look different from the paper-based version, but for researchers who wish to catch up on the latest

developments or to search for specific information, online journals are fast, convenient and offer search facilities that are simply not available in any other format.

At present, much of the information available over the Internet is free for consumers, and a great deal will remain so as part of the Open Access Initiative. Commercial publishers offer a certain amount of free material in order to keep the user interested but would obviously prefer as many people as possible to subscribe, and as more people start using the service and get used to it, with time they may reduce the amount of free material on offer. Many of the health-related web sites are supported entirely by advertising revenue and this may distort the policy of the information producer or publisher. It is to the publishers' advantage to have a quality site and to adhere to the same standards of production, with due regard for ethics and copyright, that they would if publishing in any other format.

The quality of health information on the Internet has been a subject of serious discussion among publishers, information specialists, researchers, academicians, pressure groups, NGOs, consumer associations, decision-makers and the public at large. A number of organizations have proposed codes to control the quality of health information on the web.

The question will always remain: "is the Internet the right place to look for the best information?" The quality of health information on the Internet has been at the core of a number of codes of ethics or quality standards documents. These have identified various principles that an Internet site should respect in order to safeguard the quality of health products and services on the Internet. According to Health on the Net Foundation [31], there are eight principles.

1. **Authoritative**. Any medical or health advice provided and hosted on the site will only be given by medically trained and qualified professionals unless it is clearly stated that a piece of advice offered is from a non-medically qualified individual or organization.

2. **Complementarity**. The information provided on the site is designed to support, not replace, the relationship between a patient/site visitor and his/her physician.

3. **Privacy**. The medical/health web site pledges to respect the confidentiality of data relating to individual patients and visitors to the site, including their identity. The web site owners undertake to honour or exceed the legal requirements of medical/health information privacy that apply in the country and state where the web site and mirror sites are hosted.

4. **Attribution**. Where appropriate, information contained on the site is supported by clear references to source data and, where possible, has specific HTML links to that data. The date when a clinical page was last modified will be clearly displayed (e.g. at the bottom of the page).

5. **Justifiability**. Any claims relating to the benefits/performance of a specific treatment, commercial product or service will be supported by appropriate, balanced evidence in the manner outlined in 4 above.

6. **Transparency**. The designers of the web site will seek to provide information in the clearest possible manner and provide contact addresses for visitors that seek further information or support. The webmaster will display his/her e-mail address clearly throughout the site.

7. **Financial disclosure**. Support for the web site will be clearly identified, including the identities of commercial and non-commercial organizations that have contributed funding, services or material.

8. **Advertising policy**. If advertising is a source of funding, this will be clearly stated. A brief description of the advertising policy adopted by the web site owners will be displayed on the site. Advertising and other promotional material will be presented to viewers in a manner and context that facilitates differentiation between it and the original material created by the institution operating the site.

A number of other organizations and institutions have developed their own quality criteria for their web sites. While these try to provide the best quality information services and content on the web, the end user may encounter certain risks that result in less than optimum utilization of health information on the Internet. This can happen for a number of reasons, as described by Berland et al. (2001) [32]:

- language and complexity barriers
- inappropriate audience or context
- unavailability of certain services or products in certain parts of the world
- difficulty in interpreting scientific data
- accuracy and currency of information
- potential for source bias, source distortion, and self-serving information.

The potential the electronic media hold for developing countries has been a matter for considerable discussion and debate. In general, such media are seen as having positive potential in terms of greater information access. For people in developing countries, including Africa, whether publishers or users, substantial investment is required in technology and training, and even then, if the infrastructure available does not support the capacity required, access to the information will still be slow and tedious. At the same time, the Internet offers developing countries access to more information and on a more equal basis than has ever been possible before, as well as the ability to generate and publish information that would not otherwise be made available.

Countries are encouraged to develop their own quality measures, guidelines and codes of ethics to help their populations make better judgments on what they find on the Internet and more importantly to help them develop health information products and services that provide a high-quality response to the needs of their people.

8. Sustainability of eHealth initiatives

Wikipedia [33] defines sustainability as the ability to maintain a certain process or state in any system. It is a harsh reality that many eHealth projects and initiatives in developing country settings live only for as long as external funding is maintained, and sustainability must therefore be considered from that critical point of view. WHO (2004) [34] has analysed why eHealth projects fail and provided a list of reasons why some projects are less likely to be sustainable:

- lack of proper needs assessment
- lack of vision, strategy and national plans
- lack of information and awareness about ICT applications
- computer illiteracy
- insufficient resources to meet costs
- limited experience in medical informatics
- weak information and telecommunication infrastructures
- absence of legislative, ethical and constitutional frameworks.

Other reasons for failure include:

- the short-term focus of international implementers;
- disconnection from the social, cultural and linguistic setting of the community the projects are supposed to serve;
- misalignment between international development strategies and local realities in developing countries;
- lack of institutional support for ICT projects disintegrated from health systems.

Funding is important for sustainability, but many other contributing factors have to be considered when planning eHealth interventions.

1. eHealth governance structure, policy framework and political support. The absence of these elements alienates eHealth projects and isolates them from their natural setting within the health-care sector. When eHealth policies are part and parcel of national health policies and coordinated with national ICT policies their chances for institutionalization, funding and sustainability increase.
2. Needs-based, demand-driven eHealth activities. Top-down approaches to launching eHealth initiatives result in resistance and alienation from the communities they are supposed to serve. Reaching out to individuals and communities, assessing needs and seeking solutions with them will ensure sustainability and the projects' incorporation into the community support structure.
3. eHealth has to be health-driven, not technology-driven. Pilots and demonstration projects that are lead by technology gurus to promote technological solutions are short-lived and fade as soon as a new technology emerges. Introducing cutting-edge technologies for the sake of testing, piloting and demonstration will make the bleeding edge suffer and abandon them at the first opportunity.
4. Integration of eHealth into national health systems and local settings. As health problems in many countries are system-related, eHealth solutions have to be part

of these systems. Parallel centres of excellence and vertical programmes that do not respond to or fit in with national health systems are likely to be abandoned as soon as a vertical programme moves down on the list of priorities.

5. People are at the centre of the eHealth application as users and service providers. Human resources development, localization of content, building positive attitudes and knowledge are key. Like any knowledge management system where people, technology and process meet, it is people who define success and failure. They run the technology and they implement the processes for their needs.
6. Ownership of eHealth projects through community participation, involvement of beneficiaries as prime stakeholders. Involving communities in eHealth initiatives gives them a sense of ownership and responsibility.
7. Appropriate, simple, adaptable, relevant solutions that are easy to use, culturally and linguistically acceptable and capable of solving local health problems.
8. Measurable impact. It is no easy task to measure the impact of eHealth applications and services on the health of people. That should not be an excuse for not including elements of measurement and evaluation of such initiatives. Impact can be defined as improving quality of services, reducing cost or increasing efficiency.

Countries are encouraged to develop sustainability models that serve their needs and take into consideration the different factors that influence success or failure. Among these are policy and strategy development, needs-based projects, affordability, simplicity and national funding.

9. Evaluation of eHealth projects and initiatives

Evaluation in eHealth remains a challenge as the number of national public health projects using ICTs to achieve their goals expands. There is at present no oversight mechanism providing policy- and decision-makers with a basis on which to promote a coherent, coordinated approach. However, there are strong signs that this is beginning to change.

eHealth initiatives in developing countries often suffer from fragmentation, limited implementation, the use of specific applications for a limited number of diseases (e.g. HIV in African countries), non-interoperability, limited scalability and unsustainability.

Major donors conduct evaluations that focus on cost-benefit analysis, an economic assessment methodology better suited to straightforward types of investment with easily measured returns on investment than to a complex empowering system like eHealth, which supports a wide range of activities to enhance national health systems and services. eHealth initiatives continue to be developed in an opportunistic context, but their impact and performance on the health of the populations concerned nevertheless has to be strengthened.

Evaluations of eHealth projects and initiatives must recognize a wide range of eHealth applications. This will safeguard against applying the same evaluation tools or criteria to

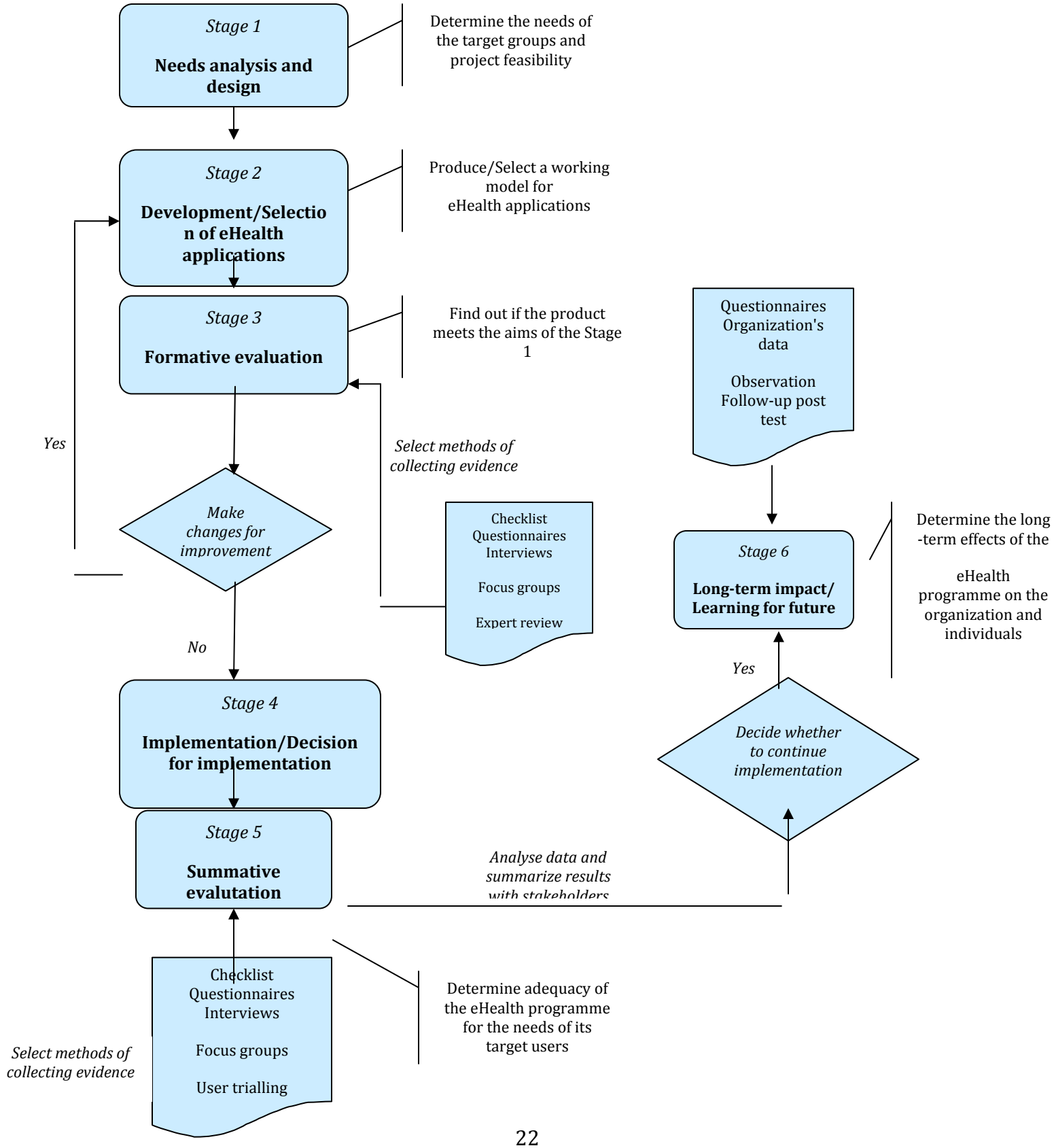
all types of eHealth activities. A health information web site on the Internet is evaluated differently from a health information system or an EHR project or an e-learning programme. The objectives are the same: to measure user satisfaction, cost-effectiveness and impact. As indicated above for sustainability of eHealth, there has to be an element of measurement and evaluation. First, the aims, objectives and deliverables must be properly defined within the timeframe and resources allocated for the project. Evaluation requires rational and purposeful data collection about the elements or indicators to be evaluated. Evaluation cannot and should not be an afterthought.

Different techniques can be used to conduct the evaluation. The questions to ask in order to collect the required data can vary. Le [35] (accessed 15 May 2009) draws up a list of possible questions:

- What is to be evaluated?
- Who is the evaluation for?
- Who are the relevant stakeholders?
- Who you will report the results to?
- What are the benefits and limitations of the projects?
- What are the cost implications for the project?
- What are the privacy, security and standards issues raised?
- How are health services performing compared to other services available?
- What resources (hardware/software/human resources) are needed?

Figure 1: Generic eHealth evaluation framework

Source: Adapted by Le from Phillips et al. (2004) [36] and LTDI (1998) [37]



10. Economic value of eHealth and impact on health

Economic value is measured in terms of what people want and is thus based on individual preferences. People express their preferences through the choices and tradeoffs that they make in the light of constraints such as income or available time.

Economic values are useful when making economic choices – choices that involve tradeoffs in allocating resources. The allocation of scarce health resources requires evidence for return on investment. This evidence is particularly poor or non-existent in the area of eHealth. There is no global consensus on which quantitative or qualitative measures (i.e. outcome indicators) should be applied when determining the value of eHealth applications. To achieve some level of quantification, generic global outcome eHealth indicators need to be established.

System and process indicators are those for which data can be easily generated. Outcome indicators tend to demonstrate the "impact" on the health of individuals and communities, an area that is particularly important for decision-makers and investors.

Investing in eHealth can be costly. Although the anticipated long-run impact of eHealth is high, in the short run the investment can represent a heavy cost to the health-care system. eHealth is emerging as a solution to work “smarter”, not harder, and as a way to attain and optimize “the impossible triad” of quality, accessibility and affordability.

The question remains: "What is the return on investment or accounting value of IT for health?" Although it is recognized that broader application of ICTs has tremendous potential to increase the value of health care, the substantial capital investment required represents a significant challenge. Despite agreement on ICTs anticipated economic value and on the need to implement ICTs across health-care settings, there is uncertainty about where, how, how much and when to invest.

In their systematic review of the cost and benefits of health information technology (HIT), Shekelle and Goldzweig (2009) [38] consider “interventions” in HIT studies to have at least four components.

- Technical: this includes the system components being tested (which may consist of computerized physician order entry (CPOE), clinical charting or electronic prescribing), the pre-existing technological infrastructure (for example, clinical and financial systems, the network) and the existing electronic interfaces and integration.
- Human factors (machine–person interface): system usability (for example, user-friendliness, system response time, intuitive user interface, support for workflow processes) and support for specialty or context-specific actions (for example, clinical content, order sets, and level and acceptability of clinical decision support).
- Project management: effecting complex socio-technical process change around HIT implementation, aligning IT and organizational resources to achieve project milestones and determining control of IT budgets.

- Organizational and cultural change: this may include partnership between medical staff and administrative leadership to govern, align incentives and mobilize organizational inertia to achieve desired outcomes through process change.

The review of 180 articles concluded that five cost–benefit studies consistently predict that implementation of an EHR system is financially viable for individual organizations or countries with high levels of health-care information exchange and interoperability. However, there are important caveats:

- all the studies are predictive analyses based on many analytical assumptions and limited empirical data;
- the strength of the evidence is weak;
- all the studies assumed that the EHR system had multiple functionalities that included, at a minimum, health information and data storage, administrative processes, decision support systems, results management and information exchange capabilities;
- the functional capability of an EHR system is critical to the benefits accrued;
- both the cost and the benefit of attaining interoperability between EHR systems are directly proportional to the level of data exchange achieved.

Unfortunately, the updated review cited above did not provide significant additional information regarding the costs and benefits of fully functional EHRs. Analyses of the costs and benefits of adding CPOE indicate that the results may be different depending on context. This reinforces the hypothesis that context is a critical component in considering the cost–benefit of clinical HIT systems.

The results of the European Commission's study [39] on the economic benefits of eHealth solutions implemented at ten European sites show that given the right approach, context and implementation process, the benefits of effective eHealth investment are indeed better quality and improved productivity, which in turn liberate capacity and enable greater access. Once the development and implementation stages have been successfully realized, the value of these benefits, for what has been called a “virtual health economy” consisting of the 10 evaluated cases, rises each year and exceeds the costs, usually very significantly. The study concluded that the annual costs are broadly stable once implementation has been completed, whereas net benefits tend to grow each year with expanding usage, showing that eHealth can contribute increasingly to satisfying citizens’ needs and wants for health care. In summarizing the economic impact of the ten studies, the report concluded that all ten cases showed a positive economic impact measured as a net benefit at present values which together exceed annual costs for the first time in year four, on average.

It should be noted, however, that it is not only the monetary values that constitute or influence the impact and value of eHealth projects. Gains in efficiency, cost-saving, improved quality, satisfaction, safety, effectiveness and better access to services and information were among the benefits identified.

11. Public-private partnerships in eHealth: the role of the private sector in building eHealth infrastructure and services

There are several financing models for eHealth activities. Countries and institutions select a model or a combination thereof in the light of the project's nature and available options. Such models include:

- public-private partnerships (PPP)
- private finance initiatives (PFI)
- public grants and loans
- research projects
- private and commercial financing, including loans and leases, as well as venture and equity capital
- public procurement, including pre-commercial procurement
- health services reimbursement mechanisms facilitating eHealth-enabled activities
- charitable donations
- citizens' out-of-pocket payments.

According to WHO, [40] the term refers to partnerships between public or governmental entities, private or commercial entities and civil society. Public-private partnerships cover a wide variety of ventures involving a diversity of arrangements. They range from small-scale, single-product collaboration with industry to large entities hosted in United Nations agencies or private not-for-profit organizations. The objectives of public-private partnerships may be:

- to develop a product, e.g. the Medicines for Malaria Venture and the International AIDS Vaccine Initiative;
- to distribute a donated or subsidized product in order to control a specific disease, e.g. initiatives to distribute leprosy medicines (concern has been expressed that such initiatives do not tackle the highest priority health problems as perceived locally);
- to strengthen health services, e.g. the Gates Foundation/Merck Botswana Comprehensive HIV/AIDS partnership;
- to educate the public;
- to improve product quality or regulation.

The MDGs are a set of 8 goals to be achieved by 2015 provided that all partners work together and do their "bit". Goal 8 specifically addresses the establishment of a global partnership for development that includes working "in cooperation with the private sector to make available the benefits of new technologies, especially information and communications".

PPPs can be a win-win situation for all partners. For the private sector it can mean high visibility, improved image, long-term higher profits at the expense of short-term donations in kind, in the form of knowledge transfer or in cash. Corporate social responsibility (CSR) is integrated into the private sector's business model for creating

economic and social value. CSR can drive philanthropic efforts for the good of humankind.

PPPs can become strong entities providing health care in developing countries. There are a number of examples of the private sector working with the public sector to deliver value at the community level. These partnerships demonstrated that coordinated global health interventions are not only possible but cost-efficient and extremely beneficial for health systems.

In WHO, this translates into eHealth PPPs. The private sector plays an important role in achieving eHealth targets. The PPPs provide the ICT infrastructure needed to enable health information content to flow. They are becoming increasingly interesting in the field of eHealth, which is the crossroads between two sectors: health and ICTs. In ideal conditions, WHO's expertise in health combined with private-sector knowledge and implementation of ICT infrastructures can yield the most favourable scenario for development with the most efficient use of resources and highest benefits.

For example, without publishers and software and hardware partners, there would be no HINARI. Similarly, through SHIPD (Access to eHealth Intellectual Property for Development), WHO aims to provide free access to the eHealth tools and services needed for development, such as clinical evidence tools.

For governments, PPPs mean that the ministry or office concerned can create the enabling framework and the private sector can deliver systems, solutions and investment.

Private-sector capability in the research and development of IT and communications-enabled systems can play a key role in delivering systems and solutions that harness the advantages of applying technology for public health, including:

- greater patient mobility (e.g. EHRs)
- stronger disease/outbreak surveillance systems
- higher quality, more timely treatment
- cost savings in the provision of services.

Private-sector involvement is often seen as a path to increased value for money, innovation and user-responsiveness.

Nikolic and Maikisch (2006) [42] concluded that the choice of private partner should be guided by well thought-through criteria in accordance with the specific need or situation (e.g., financial stability and a proven track record of experience and expertise in the field), and international best practices should be leveraged in the process of soliciting bids and awarding contracts. They added that public-private partnerships or public-private collaborations should include well-defined objectives, clear division of roles and responsibilities, risk allocation, and other transaction elements (e.g., which asset changes hands under what provisions), to be agreed upon between the partners in advance.

12. Training in eHealth (health informatics education)

One of the main challenges facing eHealth implementation is the lack of trained health/medical informatics professionals in Africa. Health informatics education may be implemented at two levels.

1. Health informatics education in support of health professionals in general, who need health informatics to manage health data and information in their role as health-care and medical professionals. This may come as part of an "Informatics education for all" programme. Health informatics can be used to train health-care professionals for the role of:

- life-long learner
- clinician
- educator/communicator
- manager
- researcher.

2. Health informatics education in support of eHealth strategy aims to prepare a generation of professionals who can plan, implement and evaluate eHealth applications. A typical health informatics programme provides:

1. learners with a theoretical and practical understanding of the role of informatics in health-care settings;
2. learners with a sound basis for implementing, developing, maintaining and managing information resources and computer systems in health care;
3. learners with skills and competences in computer use;
4. learners with the skills and tools they need to conduct research in eHealth;
5. leadership and management skills to the next generation of eHealth leaders.

An example from Africa is the medical informatics post-graduate programme at the University of Cape Town in South Africa. The aim of the programme is twofold:

a) to give students a broad background in medical informatics, to enable them to participate in the development, planning and management of information systems to support health care in South Africa;

b) to enable them to do a research project in a specialized area, thus learning research techniques and contributing to the development of medical informatics as a discipline. Students benefit from participating in a postgraduate programme in a multidisciplinary department that is firmly linked to the health-care environment.

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