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**INFORMATION AND COMMUNICATION TECHNOLOGY FOR
HEALTH SECTOR**

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I. Introduction

As we begin a new century the promise of good health for the African people seems far from reality. Although greater strides have been made over the last century in preventing diseases and extending life in the developed world, the situation in the African region remains bleak. Life expectancy in most countries has declined below that of 1960s. Africa is facing a continuous health threat characterized by ravaging epidemics, spread of infectious diseases, high levels of infant and maternal mortality, low levels of life expectancy and deteriorating healthcare facilities. The debilitating crisis caused by HIV/AIDS in sub-Saharan Africa and its impact on the spread of malaria and tuberculosis is appalling. Close to 1 million deaths occur every year due to malaria alone. Twenty-two million of the 33.4 million people infected with HIV/AIDS live in sub-Saharan Africa and 4 million have already died of it. An estimated 8 million children have been orphaned by this epidemic. The AIDS incidence is likely to diminish life expectancy by 20 years, decrease work productivity and increase infant mortality. All efforts to improve Africa's economic situation will be undermined by this disease, if comprehensive solutions are not designed soon.

These threats have already put pressures on African economies and prompted focus on increasing the availability of health care, training of more doctors and health attendants, construction of health facilities and promotion of national capacity in health research. However, the situation has not changed over the last decade. The region has continued to face declining resources for public health and poor co-ordination between medical facilities, while in contrast there is a rapidly expanding global stock of medical knowledge. The situation will worsen unless diverse modes of interventions take place.

Investments in terms of improved information systems and collaboration in this regard among African countries, other developing countries and global initiatives would make a profound change to the efficiency of health care. Information poverty is one of the most serious obstacles facing health professionals in Africa.

Education and information have long been vital tools for promoting health, controlling diseases, raising the quality of life in communities and families. The health sector is the most information intensive sector. Information is life.

Information is life!

Picture this scenario. A two-month old baby girl with meningitis was admitted to the emergency room of the hospital in a near-death situation. Laboratory tests confirmed the presence of rare bacteria in her spinal fluid. Troubled by the nature of the disease, the paediatrician in charge requested the hospital library to search for information on the infection. A search on various information resources available on the Internet lead to a "few scattered reports in very obscure journals." None of them was carried by the hospital library. Contacting other medical libraries, by telephone and fax, the required information was shortly at hand. It only took two and one half hours between log on and information to hand. The baby was successfully treated, thanks to quick access to the necessary information. Internet access made this information retrieval possible, as well as the existence of trust-worthy sites where bibliographic databases are available. This process could even be enhanced through implementing electronic document delivery systems, such as the Docline system of the US National Library of Medicine.

Many of the practical frustrations encountered by participants in the health care system in Africa can be traced to lack of accurate and timely information. Many of the deaths in Africa could have been avoided and several of the problems faced by health professionals could have been overcome by adequate information at hand when needed. Information and communication technologies could provide fast, efficient and relatively cheap access to information leading to dramatic improvements in access to advice and care.

Information and communication technologies (ICTs) are not only limited to the transfer of information. In the developed world, in addition to relaying information, ICTs are used to promote better health behaviour, to improve decision making, to promote information exchange among peers, for self care and professional support, and to enhance the effectiveness of health institutions. Innovations such as electronic medical records, hospital information systems, Intranets, public networks, health decision-support and expert systems, telemedicine, and community health information systems have altered cost, quality, accessibility and delivery of health care. All dimensions of health are now supported by ICT applications.

There are also a plethora of vehicles and media for disseminating ICT applications ranging from locally networked computers, the Internet, dial-in services, cable, satellite and other wireless modes, CD-ROM, DVD and other information storage and delivery

technologies. A combination of these technologies is breaking down the organizational barriers that have stood between care providers, insurers, medical researchers, public health professionals and actual users (the general public and patients). In addition to exerting influences on personal health decisions and behaviours, ICTs continue to offer new opportunities including improved access to individualized health information, increased potential for improved anonymity of users and promotion of interaction and social support among users, consumers and health professionals.

The importance of information and communication technologies has been highlighted recently by the decision of the World Health Organization (WHO) "to take immediate steps for telematics to become part of its health-for-all strategy for the 21st century". The potential cannot simply be ignored by Africa. ICT applications in African health care are in many instances characterised by islands of donor-supported projects that have little impact on the growing health crisis because they often prove too costly to be replicable, or are implemented in an uncoordinated way. An increasingly African-driven approach that draws expertise into an ever-widening network will have more chance of defining applications appropriate to the different needs of the continent.

II. Improved Information and Communication Technologies for the Health Sector in Africa - Implications and Challenges

The gap between the developed and the developing world that exists in information and communication services is also present in a rather dramatic fashion in the health sector. The health sector is about fifteen years behind other sectors in application of information and communication technologies. At the same time, the gap between Africa and the developed world in the health sector is widening. In the mid-1990s, for example, there was an average of one physician for every 400 people in high-income economies, while there was only one physician for every 1,000 people in low-income economies. In some African countries the ratio goes up to one doctor for every 7,000 people and in some rural areas it goes as high as one for every 20,000 people. Ironically, it is Africa that should have implemented aggressive information and communication technology application to bridge the technology gap and mitigate the shortage of health workers.

Investment in information and communication technologies in the health sector in Africa could complement basic health services provision. By replacing traditional paper-based operations with flexible electronic means, new technologies could bring significant cost reduction and effectiveness in terms of timely delivery of services in Africa. ICTs have a role to play in improving the effectiveness of the health sector as a whole by maximising the use of scarce knowledge and limited resources and facilities. New and emerging communication tools could bring life-enhancing knowledge to people in ways they can use, when and where they need it.

The main benefit of the new information and communication technologies lies in their flexibility for interaction and their ability to reach a wide range of communities.

ICTs can help reduce disparities between the services available in urban and rural areas and reduce the costs involved in transporting patients to urban facilities. They can be deployed in support of actions to limit the impact of the specific critical problem of AIDS. Information and communication technologies can play a substantial role in the following six major areas:

- improving access to health services in rural areas and primary health care;
- underpinning public education campaigns to promote healthy behaviour in critical areas such as AIDS;
- transferring diagnostic information to specialised centres;
- strengthening the basis for decision making;
- promoting information exchange among researchers and students; and
- enhancing the effectiveness of health institutions.

(i) Improving Primary Health Care

Primary health care is a task-oriented process that deals with common health problems in communities. It is the most challenging area in Africa since over 90% of the population live in rural and peri-urban areas and need close attention. In most cases the attention is as basic as improving access to information to change the health behavior of communities. But it generally involves educating communities on the prevention of health problems, promotion of a better choice of food, supply of safe water and basic nutrition, provision of child care and family planning, immunization against major infectious diseases, prevention and control of local endemic diseases, treatment of common diseases and injury, and provision of basic and essential drugs.

A number of stakeholders are involved in providing primary healthcare. One of the immediate benefits of information and communication technologies is in providing optimal communication with all health care service providers. In addition ICTs have the following roles in the improvement of primary healthcare in Africa:

- Assist in population-based data collections – from community to national levels – that reflect disparities in health status and care and that are crucial to a more equitable health care approach;
- Enable the establishment of community health information systems and networks that combine local knowledge with information from health providers and that help to gather and transfer key determinants of health. These could play an important role in monitoring health status, promoting community responses and

diagnosing community health problems, including those related to maternal and child mortality;

- ICTs are significant in automation of processes and promotion of international coding and networking for epidemiological surveillance; and
- Health information can be programmed into community radios and telecentres or Multi-purpose Community Centres; action research is needed to determine the most appropriate media.

Global health information initiatives to benefit Africa

There are currently various international initiatives aimed at delivering health information to developing countries. These are in essence all planned with very benevolent aims to improve the situation at the primary health care level. There is proof of the commitment of the organisers and funding bodies behind such initiatives. However, these initiatives are in many instances uncoordinated and may at best constitute attempts at addressing the needs of developing countries as perceived by the developed world. It is viewed as essential that African health policy makers should take cognisance of these initiatives and view them as an excellent resource to improve health information flow to various categories of end users – from frontline health workers to community organisations and individuals seeking health information. The ADF should urge decision makers within these structures to investigate ways of appropriate collaboration. Such collaboration will hopefully result in: more focus in terms of responding to country- and region-specific health needs; economies of scale in terms of ICT infrastructure roll out; and, local end-user involvement to the extent that true reciprocal flow of relevant information can happen.

The following list provides an indication of such initiatives:

- Interactive Health Network – Director Dr Harry McConnell – is geared towards the frontline health worker. The goal of the Interactive Health Network is to establish a broad-based interactive community for healthcare workers. This interactive community would increase the exchange between developing and developed countries, between NGOs working in international health and between local practitioners and volunteers from outside agencies. This will serve the primary purpose of increasing health promotion and medical education in order to facilitate accurate diagnosis and treatment. The Interactive Health Network will provide content and assistance in co-ordination with global health information initiatives. (hmcconnell@compuserve.com).
- The Health InterNetwork for Developing Nations – a very ambitious project. The InterNetwork will serve as a two-way communication system between health professionals within developing countries and also around the world.

Its goal is to install 100 Internet-accessible computers in each of the 130 poorest countries selected for this venture. Cost: in the region of 150 to 200 million dollars.

- SHARED – a system funded by the EU to promote interaction among health researchers in developing countries. Researchers are invited to post information on their research projects and indicate their areas of interest. The data are in many instances outdated. The project is co-ordinated by Dr Barend Mons. (<http://www.shared.de/sharedhome.html>).
- SatelLife - well-known for its healthnet listserv in African countries (still mostly based on old FidoNet technology).
- Afro-Nets listserv – co-ordinated by Dr Dieter Neuvians of GTZ in Harare – a very useful service.
- The International Network for the Availability of Scientific Publications (INASP), launched in April 1996, is a co-operative network of partners aiming to improve world-wide access to information – refer <http://www.inasp.org.uk/>. INASP-Health promotes 'access to reliable information for health professionals' as a key development issue, as potentially the most cost-effective approach to sustainable improvement in healthcare in developing and transitional countries. It links with the WHO-HIF Cooperation Programme and is managed by Dr Neil Peckenhams Walsh (e-mail: inasp@gn.apc.org).
- WHO initiatives such as:
 - WHOLINK library and information networks.
 - The WHO Blue Trunk Library project in some 20 African countries, providing a collection of manuals and texts to district health centres, organised in a blue trunk which acts as a mini library – regarded as a valuable complementary (manual) system (bertrandi@who.ch).
 - The African Index Medicus (shakakatar@whoafr.org), produced under the auspices of WHO AFRO and the Association for Health Information and Libraries in Africa (AHILA) <http://www.who.int/hlt/countrysup/aim/English/aim.htm>.
- World Bank – e.g. HNPFLASH newsletter service.
- UNAIDS is currently spending \$15 million to install Internet backbones in 20 African countries. In April 2000, a network was launched to counter the spread of HIV/AIDS. Supported by the UNAIDS, this network, the first of its kind in French, was described as an important step to "broaden the exchange of information and experiences, strengthen advocacy efforts, promote prevention measures (and) reinforce access to care and treatment" in one of the areas hardest hit by the HIV/AIDS pandemic.
- Multi-lateral Initiative on Malaria (MIM) - with the US National Library of Medicine (NLM) investing in Internet connectivity to and document delivery services via the University of Zimbabwe and the South African Medical Research Council. (<http://mim.nih.gov/> and <http://www.mimcom.net>).
- Dissemination centres initiated about three years ago by the Commonwealth Regional Health Community Secretariat for East, Central and Southern Africa - e.g. the Uganda dissemination centre on nutrition and reproductive health (fkalyowa@usa.net).

- The system for HIV/AIDS information management and dissemination in Senegal in collaboration with UNAIDS - making information available on the Internet and in printed materials (bobibrahim@yahoo.com/aciannex@enda.sn and <http://www.acibaobab.org>).
- Multipurpose Community Telecentres:
The International Development Research Centre (IDRC), The United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the International Telecommunications Union (ITU) have all been instrumental in undertaking a new form of collaboration and partnership in pursuing these pilot projects. They are fusing their respective organisational cultures in an effort, not only to build successful models for rural African telecentres, but also for international co-operation for social and economic development. (<http://www.idrc.ca/acacia/outputs/lemonade/lemon.html>).
- Public Health Channel:
In May 2000, the US-based WorldSpace Foundation and SatelLife launched a health information system to supply a "steady stream of material to assist medical professionals in Africa in the diagnosis, prevention and treatment of diseases that are ravaging that continent. Called the Public Health Channel, and created with a range of "high-quality information resources", this service seeks to combat such diseases as tuberculosis, in addition to HIV/AIDS, through a steady 'dose' of relevant medical assistance.
- Health Information for Development (HID) Project – towards a network of health information resource centres, with at this stage the focus on connectivity and ICT capacity development to enable access to health information. The Health Information for Development project is the first phase of a \$45 m/£30m Information Waystations and Staging Posts project, which aims to upgrade selected resource centres into Information Waystations and create a network. In a further phase, some Information Waystations will become Staging Posts to adapt and republish health information. Director: Dr Chris Zielinski (e-mail: dvt@compuserve.com; URL: <http://www.iwsp.org>).
- The HELINA listserv and web site for health informatics in Africa, (<http://www.uku.fi/english/organizations/helina-l/>).
- The renowned Cochrane Library, designed to supply high quality evidence to inform people providing and receiving care, and those responsible for research, teaching, funding and administration at all levels, (<http://www.update-software.com/cochrane/cochrane-frame.html>).

Arguably the most comprehensive site on connectivity in Africa is that of Mike Jensen. The information published on this site may assist policy makers in reviewing the investments in ICT in Africa - (<http://demiurge.wn.apc.org:80/africa/>- e-mail mikej@sn.apc.org).

The Interactive Health Network initiative has indicated that it is planning a videoconference for 18 July 2001 through involving the multiple global initiatives aimed at developing countries to discuss mechanisms for closer collaboration.

To be effective in an African context, these global health information initiatives would need Internet availability and sufficient bandwidth. This is a challenge to governments and organisations wishing to invest in telecommunication infrastructure. The digital divide of developing countries (and Africa in particular) in comparison with the developed world is a reality. According to the World Bank the number of Internet hosts per capita increased 29 per cent in sub-Saharan Africa in 1997–99, compared to 87 per cent in OECD countries. However, there are promising signs. **Even in war-torn Somalia entrepreneurs have set up four independent telephone companies, both fixed landline and cellular, and recently banded them together to offer Internet service to users.**

(ii) Transferring Diagnostic Information to Specialised Centres

Rural communities in Africa suffer from lack of primary care physicians or specialized health care professionals. The chronic shortage of doctors and mid-level practitioners in rural areas will not abate in the near future. Information and communication technology applications such as telemedicine present a considerable opportunity to narrow the expertise gap in rural areas. Telemedicine makes remote areas more accessible by giving them immediate electronic access to up-to-date information and resources, specialists for consultative purposes, continuing medical education, and to other colleagues. By reducing the need for referrals, it helps patients remain in their communities, provides faster, more convenient treatment and minimizes the disruption of the patient's life.

However, in many rural areas, the communication infrastructure is unable to support the bandwidth necessary to carry the signals for telemedicine using two-way interactive video. In addition, the costs of connections between local and long-distance telecommunication carriers can pose a significant barrier to telemedicine projects. Under the existing tariff structures, telephone calls placed in locations within the local access transport area boundaries are often more expensive than those placed outside the same service area. Ethical issues need to be taken into account in planning a telemedicine system. Telemedicine raises some difficult legal and regulatory issues as well. Obviously a system of referral sites must be in place – usually tertiary hospitals.

Despite these challenges telemedicine plays a significant role in transferring diagnostic information to specialised centres. Recent technological advances such as fibre optics, integrated services digital networks, and compressed video have eliminated or minimized some of the problems (e.g. poor quality images and slow transmission speeds) that limited earlier applications. Currently, there is much interest in the potential of telemedicine to lower costs, improve quality, and increase access to health care, especially for those who live in remote or underserved areas.

Pilot tests are also under way to test the feasibility of delivering a variety of services directly to consumers in their homes. The extension of telemedicine services in rural or underserved urban areas would have the following potential benefits in Africa:

- Promoting access to specialists for diagnostics in areas of chronic shortage including radiology, pathology, dermatology, ear-nose-throat speciality, emergency care/ambulance, cardiology, EKG-transmittance, physiology, endoscopy, Surgery (e.g. neurosurgery and orthopaedics);
- Improving consultation between remote health workers and specialists in the above fields;
- Education and life-long learning for remote healthcare providers; and
- Support for primary and home care especially for homebound chronically ill and frail elderly persons whose mobility is limited by illness, transportation costs, or other factors.

Pilot telemedicine projects in Africa:

Telemedicine has grown substantially in sophistication and acceptance over the past three years. Some examples in Africa include:

1. University of Transkei

Situated in remote area of Eastern Cape of South Africa, doctors have been sending pathology, X-ray and dermatology images for consultation for the last few years. They use simple and cheap Internet technology. They use videoconferencing on a daily bases for educational and administrative purposes through broadband phone lines.

2. Medical University of Southern Africa (MEDUNSA)

MEDUNSA provides telemedicine specialized consultation in pathology, dermatology and radiology for the University of Transkei and other medical schools or hospitals in Africa.

3. University of Natal

The Department of Radiology of the University of Natal has been providing service to rural hospitals around Durban for the last three years. Good local expertise has been built at the university in digital radiology imaging.

4. Tele-radiology between Beira and Maputo

Supported by the International Telecommunications Union a hospital in Beira sends x-ray images to Maputo for consultation.

5. Telemedicine in Dakar

The Lille Regional University Hospital (CHRU) and the European Institute of Telemedicine in Toulouse developed videoconference applications for distance learning and consultation in the areas of obstetrics and gynaecology. Plans to extend the link to Saint-Louis hospital and other district hospitals are underway.

The software choice for a telemedicine service in an African context should be carefully considered. The bandwidth restrictions would most likely require store-and-forward solutions. According to Interactive Health Network a software option to consider would be Second Opinion Software, because they offer a multimedia patient record that offers unique capabilities from other packages. It can be easily customized to form a specialized function of serving as both patient record and central database. The encryption technology is built into the software package so that no additional third party software packages will be necessary. This encryption can be individualized and password protected for individual files to ensure that individual records are accessible only to those intended. Use of Second Opinion Software will ensure that all physicians are communicating using the same platform and a means that will assure security of patient information and be user-friendly. In such a system all patient information will be kept on a secure server at the Second Opinion offices in Los Angeles where they will be password protected for server access. Patient information will further be made anonymous through unique number identification allocated by the treating primary physician and will be accessible using thin client technology. A thin client solution can be utilized to ensure secure access so that the patient information remains at all times on the server and is not downloadable or accessible by other than those physicians for whom the information is intended.

In South Africa 28 telemedicine pilot sites over 6 provinces are scheduled to be operative by March 2001. These sites use ISDN connectivity (two bundled lines per site to achieve 256 Kbps bandwidth) for videoconferencing and also have store-and-forward facilities. It is planned to have 75 such sites available divided into various provincial networks by March 2002.

(iii) Improving the Effectiveness of Health Services

Observation shows that the current operation of health services throughout the region is grossly inadequate. The recording procedures in most hospitals leave much to be desired. Manual systems are prone to enormous inaccuracy hindering the flow of information and impeding the integration of healthcare delivery, research and administration. Lack of adequate and organised information is the source of patient frustration and mismanagement of resources and time.

A clinical information system that covers patient records, bed-side data, lab reports, pharmaceutical receipts, and that caters for demographic movements between hospitals is required to reduce cost and waste of resources and to support needs of a wide range of users. A well-designed hospital information system could have a substantial impact on the cost and quality of service and the health care in the region. Computer-based patient records are becoming vital for doctors, nurses and other health professionals in order to provide an array of hospital, primary care, and other ambulatory and institutional health services. Individuals need their personal computer-based records that include longitudinal health profiles for those who move frequently and those with complex medical conditions.

Improved healthcare management through ICTs cannot be achieved without a concerted effort at national level. The healthcare delivery system has several features that discourage use of information and communication technologies. Health professionals perform a wide variety of tasks including rapidly changing combinations of "hands-on" care, inductive and diagnostic thinking, detailed record-keeping, patient education, and communication with colleagues. In addition, medical practice is extraordinarily complex and it changes rapidly. Information technologies tend to alter the organizational settings of health workers that are generally rigid and hierarchical. Thus at country-specific level there is a need for:

- A national health information system that has many components from electronic patient records to drug databases (including traditional herbal remedies) to the management of facilities.
- A resource centre for sharing experience and knowledge as components developed in different countries could reduce costs and facilitate implementation.

Computerised District Health Information Systems – basic building blocks

Health systems in Africa consist of various organisational components. From a country-specific information management point of view it would seem that district-based health systems provide an appropriate mechanism for the delivery of effective primary health care services in Africa.

District-based health systems can therefore be viewed as the appropriate primary level organisational component – the basic building blocks of the health system.

The WHO defines a district health system as follows: A district health system, based on Primary Health Care, is a more or less self-contained segment of the national health system. It comprises first and foremost a well-defined population, containing 50 000 to 500 000 people, living within a clearly delineated administrative and geographical area, whether urban or rural. It includes all institutions and individuals providing health care in the district, whether governmental, social security, non-governmental, private or traditional. A district health system, therefore, consists of a large number of various interrelated parts that contribute to health in homes, schools, work places, and communities, through the health and other related sectors.

At the district health level, information systems should primarily be developed to cater for the particular local needs. In many instances manual information systems will be a logical starting point. However, the challenge is to move to computerised district health systems. The patient health data collected for further dissemination into the health system would normally be of an aggregated nature. Such data and those on the resources used at district health systems sites would be an important component in the management information flow to understand and make informed decisions about the management of the health system.

Information systems developed to serve district health systems should allow the necessary information flow to the next level in the health system, such as to secondary and tertiary health facilities, the provincial health management level and eventually the national health authorities, in a logical hierarchy. Lateral flow of information among district health systems should also be promoted.

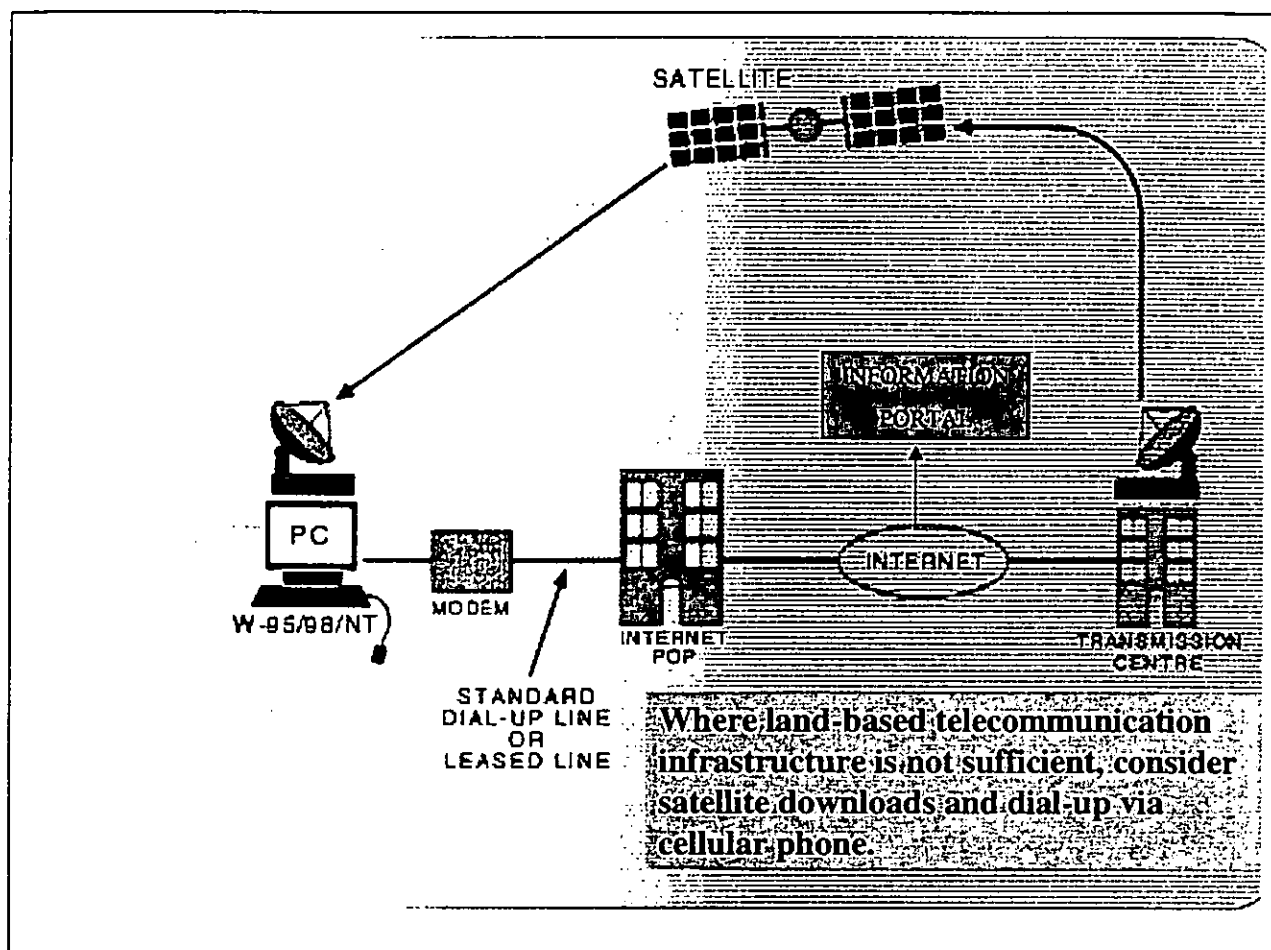
In South Africa a standardised district health information system, HISP is currently in the process of being rolled out in all provinces. The same system is being rolled in Mozambique.

The following issues come to the forefront:

- Although only aggregated data may be made available via district health information systems the quality of input data should not be compromised.
- Training of district health system staff is considered very important in terms of sustainability.
- The provision and installation of hardware and software should aim to involve local SMMEs in partnership arrangements, or to build capacity among local people towards the establishment of SMMEs.
- Establishing district health information systems should logically be linked with the concept of creating Waystations, Staging Posts and Multi-purpose

Community Centres (sometimes referred to as telecentres), in areas under-serviced in terms of ICT infrastructure. A symbiotic relationship could exist where the community information service not only caters for the dissemination of health information (e-health), but also provides a feedback loop into the health system on the health needs of the particular community.

- The use of wireless technology should be considered as an option where modern ICT is introduced in buildings or temporary structures not designed for such infrastructure. In future technology (such as Bluetooth) may further enhance the ability of flexible LANs and the linking of relevant equipment.
- Internet connectivity is in some instances not necessarily a given for district health information systems, but this should be promoted. Connectivity to an Internet Service Provider (ISP) may be by way of normal telephone landlines, but in the light of the expanding cellular telephone networks in Africa, the cellular telephone should not be ignored. Although the bandwidth achievable via a cellular phone connection is currently restricted to 9.6 Kbps, new technology is on the horizon that will allow at least comparable speeds to landlines and eventually much faster. When making use of cellular or landline connectivity to an ISP broadband Internet downlinks may be established via satellite – refer to Fig. 1. There are currently providers for such services in Africa.
- Radio-based links between district health system sites and others sites in close proximity (approximately 10 kilometer range) may be an option to consider. This will allow broadband transmission. However, some telecommunication authorities may prohibit the use of such systems.
- Where Internet connectivity cannot be achieved, the use of CD-ROMs for access to essential health information should be promoted. The flow of essential aggregated health information, in the absence of Internet connectivity, to other higher levels in the health system should be done by way of diskette or CD-ROM
- District health systems would be a logical level to introduce store-and-forward telemedicine functionality that can be used for discussions of diagnostic and treatment dilemmas for healthcare workers at the district health system. This would be in line with the planning of the Interactive Health Network initiative.
- District health systems would be suitable nodes for information flow to the communities they serve (health promotion) and should allow reciprocal information flow about the local health needs.
- District health systems linked to the Internet would allow professional bodies and training authorities to introduce remote continued professional education to health workers.



Hospital information systems

Hospital information systems are primarily there to support hospital activities on operational, tactical and strategic levels. However, they form another level of important building blocks in the national health system to allow appropriate management of the resources at the institutions involved and to allow relevant (aggregated) management information flow to appropriate levels of control. In South Africa for example there is a system in place to request a standard monthly hospital report form from public and private sector hospitals, which is complementary to the information systems at individual hospitals. Computerised hospital information systems are being implemented in an increasing number of hospitals.

Various such systems are already operative in other African countries. Examples are the systems implemented at the National Cancer Institute at Cairo University and in Ile Ife in Nigeria. The build-or-buy choice needs to be carefully considered, since these are expensive investments.

Health information standards

African countries should give more attention to appropriate health information standards. One mechanism could be to seek more prominent representation on the relevant international bodies, to ensure that the standards developed at these forums meet the needs of developing countries. The Technical Committee (TC) 215 of the International Standards Organisation (ISO), dedicated to health informatics standards, has South African representatives as active members, with Zimbabwe having observer status. Regional co-operation in this regard should also be entertained. The SADC region has started with some collaborative initiatives linked to SADCSTAN, including an invitation to countries in this region to participate in the South African Bureau of Standards (SABS) SC71D Health Informatics planning, which is the local TC215 mirror committee.

(iv) Medical Education and Research

Medical knowledge is a dynamic and fast growing area. More than 360,000 articles are published yearly in medical journals worldwide. The average medical library in the United States has 3,000 journals in its collection - many African libraries often have less than 30 titles! The shift of medicine from intuition, unsystematic clinical experience, and patho-physiological rationale as a ground for clinical decision-making to evidence-based medicine that stresses the examination of evidence from clinical research has already heightened the need for up-to-date information. This requires that medical researchers and practitioners have access to a wide array of information and apply formal rules of evidence in evaluating the clinical literature.

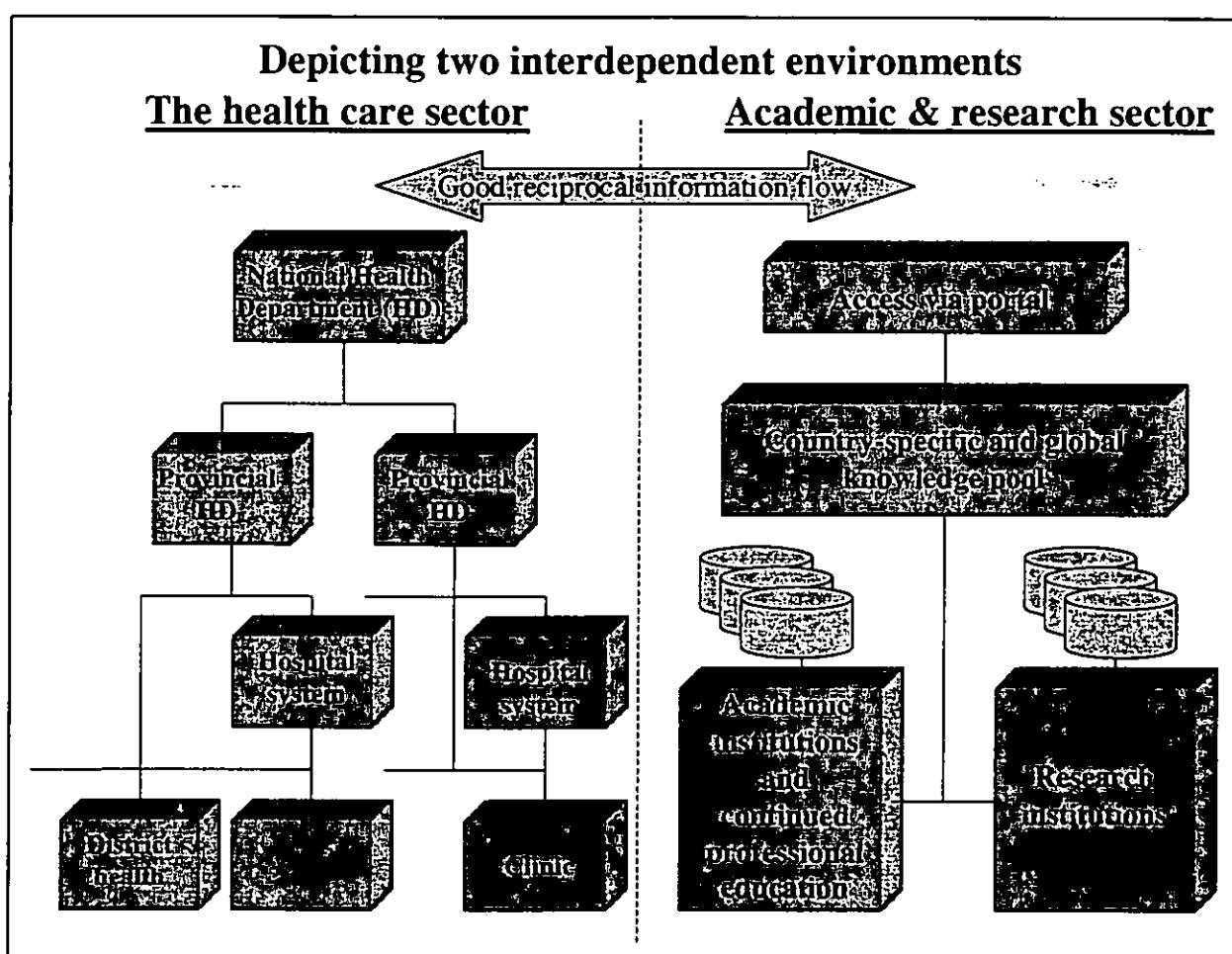
Lack of access to information by health care providers and medical students means that those in Africa not only have difficulty in keeping up with the magnitude of medical literature and guidelines for practice but are also alienated from each other in sharing experiences and evidence. New medical knowledge is being developed and distributed on the Internet, with potentially universal access and open distribution. Professionals and ordinary citizens must have access to a continually updated repository of current knowledge that meets "best evidence" criteria for accuracy and reliability. In addition to the latest information, other types of decision support systems are needed to help clinicians choose the interventions shown by evidence to be associated with the best health outcomes. In order to achieve this:

- Medical informatics must be introduced into the regions' medical schools – highly specialised programmes can be shared electronically - programmes developed in Africa can be marketed elsewhere in the world;
- Research networks should be established locally, sub-regionally and regionally to increase understanding of the specifics of Africa's health care problems, promote collaborative research and disseminate information on telehealth projects;
- Continuing medical education using new information and communication technologies should be promoted in order to save costs, to improve access to a wide array of opportunities and specialists and to access technologies that could be used to broadcast education to other institutions.

(v) Linking the health care sector with the educational and research sector

It is important to ensure that the health care sector does not develop information systems in isolation or ignoring the necessary interfacing with the valuable information resources in the educational and research sector – and vice versa.

Fig. 2 depicts the interrelated nature of these two sectors.



(vi) ICTs Deployed in the Fight Against HIV/AIDS

Two-third of the world AIDS population lives in Africa. Africa cannot ignore the AIDS case even for a second as it is continuing to kill more people per second, to orphan more children and to exacerbate poverty and inequality.

Although limited work has been done in the use of information and communication technologies in the fight against HIV/AIDS in Africa, it is clear that ICTs could have a substantial role in carrying information and messages to all that are affected by the pandemic and to the governments and practitioners coping with the alarming health and economic situation resulting from the disease.

Government initiatives to provide information about the distribution of infection, behaviours that spread HIV/AIDS and mitigation programs can greatly benefit from good use of information and communication technologies. Knowledge about the levels of HIV infection, information on patterns of sexual behaviour, condom use, and drug-injecting behaviour is important to determine the baseline shape of the AIDS epidemic. Countries at all stages of the epidemic need information on the prevalence and distribution of risky behaviours among representative samples of men and women in order to understand the likely path of the epidemic and how it can be minimized. However, this information remains scarce in Africa. In general:

- Electronic data collection and geographic information systems can be developed to map the disease within countries and regions;
- Multi-media approaches can strengthen the delivery of public education messages;
- Networking of health professionals can accelerate the introduction of new treatment and prevention methods;
- Patients' networks can break down the sense of isolation and strengthen their public voice. There is a large and growing community of people using computers worldwide to provide help and support to one another on the AIDS pandemic.

Detailed recommendations, presented at ADF 2000, are included in Annex 1.

Information systems aimed at addressing the HIV/AIDS problem

The HIV/AIDS epidemic in Africa requires concerted action. All interventions, ranging from clinical and behavioural to policy making for optimal health system solutions, need a sound information system to allow appropriate knowledge flow in the total system. HIV/AIDS also raises complex new public health, human rights, ethical and legal issues throughout the world. These issues particularly come to the forefront in terms of HIV/AIDS vaccine development, clinical trials and, eventually, potential vaccination. Populations need the skills to understand these issues and act upon them in the most informed and appropriate ways. Vibrant, creative and innovative education and information campaigns are needed that address the failures of the past, expand the current successful programmes and introduce hope for an end to the HIV/AIDS epidemic. Such interventions need to be underpinned by a shared methodology and knowledge base. Various initiatives in the area of HIV/AIDS are abound.

An example in terms of intercontinental collaboration for improved HIV/AIDS information flow is the so-called Exchange Programme (Health Information Forum), which was officially launched in London on 8 March 2001 with an international videoconference that linked a range of sites in Africa, Europe and North and South America. Exchange is a networking and learning programme which aims to facilitate the development of a strong and effective UK health communication sector that works in partnership with Southern organisations to encourage collaboration, strategic action, sharing of good practice and better impact.

Another noteworthy initiative in this regard is the International Partnership Against AIDS in Africa (refer <http://www.unaids.org>). This initiative is a coalition of actors who, based on a set of mutually agreed principles, have chosen to work together to achieve a shared vision, common goals and objectives, and a set of key milestones. Its purpose is to establish and maintain processes by which governments, civil society, national and international organizations working against AIDS in Africa are enabled to work together more effectively to curtail the spread of HIV, sharply reduce its impact on human suffering, and halt the further reversal of human, social and economic development in Africa.

The actors of the Partnership are:

- African governments
- The United Nations
- Donors
- The private sector
- The community sector

The vision of the International Partnership Against AIDS in Africa is that within the next decade African nations with the support of the international community will be implementing larger-scale, sustained and more effective multisectoral national responses to HIV/AIDS.

Through collective efforts, promotion and protection of human rights and promotion of poverty alleviation, countries will:

- *Substantially reduce new HIV infections;*
- *Provide a continuum of care for those infected and affected by HIV/AIDS;*
- *Mobilize and support communities, NGOs and the private sector, and individuals to counteract the negative impact of the HIV/AIDS epidemic in Africa.*

In the planning documents of the International Partnership Against AIDS in Africa it is stated that: *All partners would have prompt access to the information they need through an information-sharing system established and managed by UNAIDS secretariat.* Although the vision of a central system should be supported, it is advisable also to invest in country-specific or regional HIV/AIDS information systems.

Such country-specific or regional knowledge resources are necessary to facilitate collaboration and knowledge sharing among institutions involved in the prevention of HIV/AIDS. These systems should be accessible via modern web portals that will serve as information clearinghouses. Specific information products, research instruments and methodologies developed can be shared on the portal sites. These portals should also allow for peer interaction (discussion groups and collaborative document authoring) and would serve as central repositories for hard copy products. An HIV/AIDS portal project should be integrated with the particular existing country-specific research and provide the knowledge hub for such research. Apart from health promotion research and intervention issues pertaining to behaviour and changes in social norms – such as promoting abstinence, limiting sexual partners, encouraging the use of condoms and issues regarding voluntary testing for HIV status – the (proposed) system should also focus on HIV/AIDS vaccine development and clinical trials. At the same time portals should attend to other information flow aspects relating to the epidemic, such as epidemiological data and information products to support the education system.

(vii) Novel ICT issues to be considered

□ Building a health information portal

The purpose of an information portal is to deliver comprehensive and unified access to a heterogeneous collection of information sources through a secure access layer. It could logically be linked with the concept of information flow via Waystations or Multi-purpose Community Centres – refer to Fig. 3. Specific functionality to be addressed includes:

- Personalisation and notification – allowing users to select and receive information relevant to their interests and roles.
- Searching – the ability to search for information buried across multiple formats and sources.
- Unified access – organizing and disseminating information assets, whether structured (databases, spreadsheets) or unstructured (e.g. documents, web pages).
- Strict security models – ensuring various levels of security to ensure information is accessible yet protected.
- Content submission and sharing – allowing collaborators to share valuable information in a simple, effective manner.

- Intelligent classification – allowing the subject matter to be organized according to various standards and taxonomies (e.g. scientific, legal, public categorisation).
- Common terminology – the portal will provide a medium to establish a common metadata repository, ensuring consistency in understanding of information.

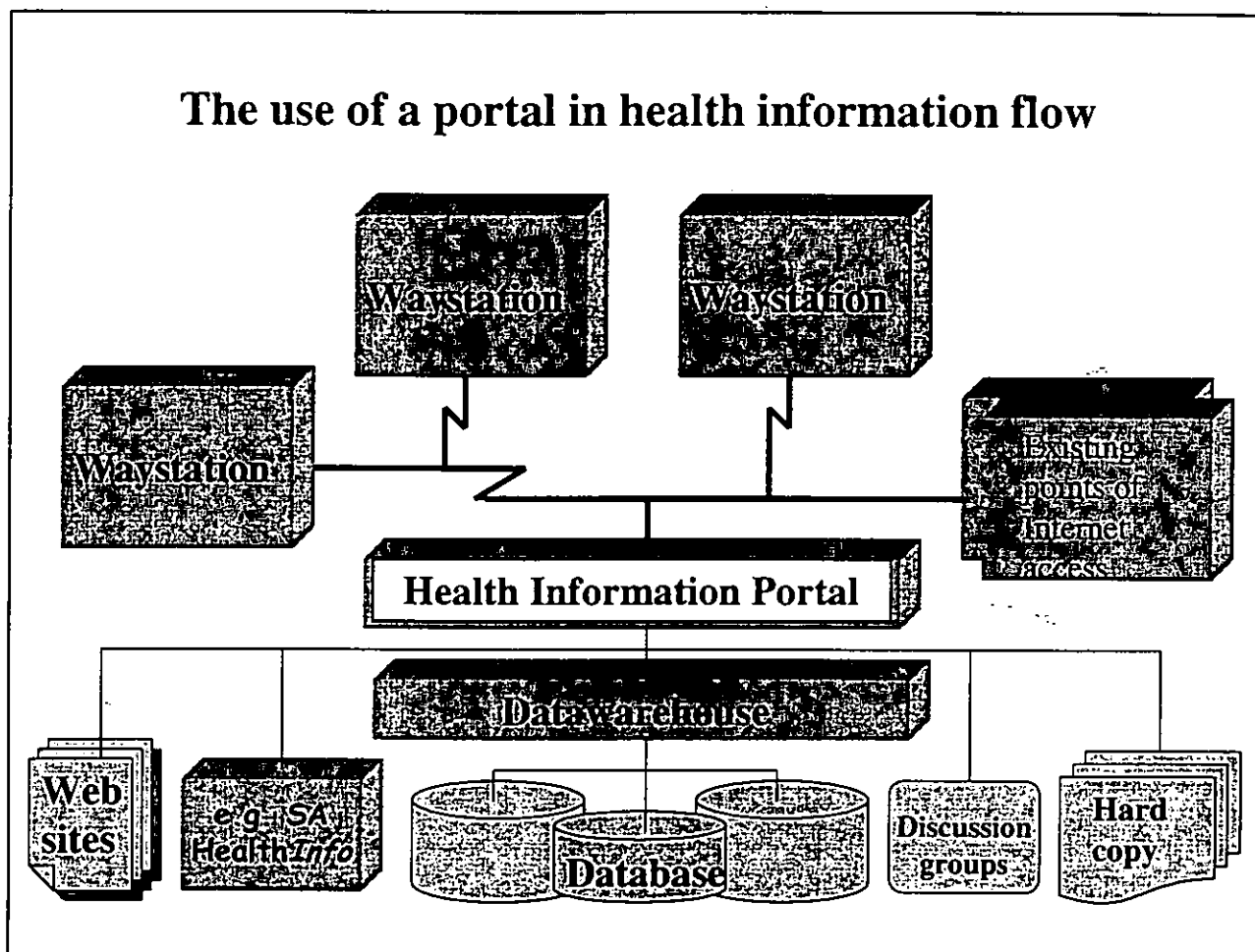


Figure 3: Depicting the use of a portal in health information flow

The process of building an information portal requires a number of different activities and skills:

- A comprehensive business analysis phase will uncover the detailed purpose, processes and usage patterns, as well as understanding existing sources of information to be incorporated into the portal.
- A development phase will involve the establishment of the physical infrastructure, data population routines, information delivery mechanisms and security infrastructure.

- A carefully planned and managed testing and implementation plan will ensure that the system is thoroughly tested and that the delivered system meets the initial business requirement.
- Ongoing maintenance and refinement is critical to ensure the system has high availability, superior response times and is consistently updated with new and innovative features.

□ **The use of voice-based systems**

The notion to use voice-based systems as part of the information delivery chain is very exciting. Where health information delivery takes place at the community level one is obviously confronted with the problem of users who are not computer literate. However, these people could easily be coached to 'talk to the computer'. The idea is to develop health information packages on certain health topics - such as HIV/AIDS and sexually transmitted diseases - where these allow a two-way flow of communication based on frequently asked questions and answers. Information delivery could be via broadband links with a portal site or via CD-ROM. The idea is that information delivery must happen in the language of choice of the end user. Such a system is currently considered by the University of South Africa and the South African government's Communication and Information Services (GCIS), for development and implementation in South Africa. If successful it may be a useful model to consider for rolling it out to other African countries. More information on this concept is available from JANUS at <http://isl.ira.uka.de>.

□ **Catering for Biological Resource Centres**

Worldwide attempts to preserve biodiversity and the information and materials generated by the genomics revolution present a significant new challenge to governments and industry. African health policy makers should also note the international initiative under the auspices of the OECD to establish Biological Resource Centres (BRCs). The OECD definition of Biological Resource Centres is as follows: "Biological resource centres are an essential part of the infrastructure underpinning biotechnology. They consist of service providers and repositories of the living cells, genomes of organism, and information relating to heredity and the functions of biological systems. BRCs contain collections of culturable organisms (e.g. micro-organisms, plant, animal and human cells), replicable parts of these (e.g. genomes, plasmids, viruses, cDNAs), viable but not yet culturable organisms, cells and tissues, as well as databases containing molecular, physiological and structural information relevant to these collections and related bioinformatics." "BRCs must meet the high standards of quality and expertise demanded by the international community of scientists and industry for the delivery of biological information and materials. They must provide access to biological resources on which R&D in the life sciences and the advancement of biotechnology depends."

African countries should plan for building the necessary information systems that would support BRCs, protect African interests and support the exchange of information and material.

III. Integrated National, Sub-Regional and Regional Response

Surveys of current information and communication technology applications in the health sector in Africa show a gloomy picture. Regional initiatives are few. The majority of these are donor driven. Although donor investments have contributed to an extent, ad-hoc support to the health sector without local involvement or real responsiveness to local demands has produced only limited impacts. One of the main reasons for limited impact is that relatively little attention has been paid, by the development aid agencies, the private or the public sectors, to the applications that could improve the capacity of communities to carry out the non-clinical or population-based functions of public health. ICT-based community driven approaches are crucial since they provide opportunities for primary prevention that reduce infectious risk factors, promote healthy life styles and behaviour and limit the spread of epidemics.

Examples of ICT projects in the health sector in Africa

- ❑ Mapping Malaria Risk in Africa (MARA) – a Geographic Information System-based network for mapping the malaria risk in the region
- ❑ Healthnet – global health communication system that initially used low cost low-earth orbit satellite to connect doctors from over 13 countries in Africa
- ❑ The African Programme on Onchocerciasis Control (APOC) made extensive use of ICT in its effort to control river blindness in west Africa
- ❑ Droits et sante pour les femmes d'Afrique Francophone based in Senegal that provides training to women in ICT use for community health
- ❑ SYFED-Refer a network for healthcare workers in French speaking African countries
- ❑ The South African National Health Knowledge Network (SA HealthInfo)

- The South African health knowledge network aims to provide a one-stop interactive forum/resource, for quality-controlled and evidence-based health research information, to a wide spectrum of users, at various levels of aggregation, with the necessary security arrangements and facilities for interaction among users to promote explicit (codified) and tacit knowledge flow. It takes into account the principles of knowledge management and the drivers of a system of innovation. This system provides access to its own unique databases and static information in HTML format, as well as acting as a portal to external trusted sources of health information. URL: <http://www.sahealthinfo.org>.
- Various other initiatives as indicated elsewhere in this document.

Another characteristic of information technology use in the health sector is fragmentation. Government sponsored health care, private surgeries, medical research, research institutions, public health centres, etc. are all operating independently and are managed by universities, businesses, governments, individuals, families, and communities that invest in information technologies differently. This has led to islands of automation with few links among them.

Thus, there is a need for holistic approach at national levels. Governments need to define standards and provide the technological infrastructure and services required for the use of ICTs in health. They also need to set up incentives to encourage ICT health applications (e.g. reduction of tax rates on equipment and of telecommunication service tariffs, introduction of rates for rural areas that are equivalent to those for urban areas, preferential flat rates, etc.). Infrastructure challenges in the health sector cover high-tech and low-tech solutions. Some health communication interventions using traditional media, such as radio, television, and printed text and pictures, have been effective in improving knowledge and promoting healthy behaviours. The major gaps in health information access include:

- Improving access to telecommunications and computing infrastructure;
- Increasing the availability of applications;
- Expanding computer literacy;
- Improving consumer demand for health information;
- Surmounting resistance;
- Developing strategies for bridging the financial resources gap especially in the initial implementation and maintenance costs.

In addition, the public and private telecommunication operators should guarantee access to broadband applications. Education institutions should promote networks that open access to students and faculties. Such involvement of multiple stakeholders necessitates a coordinated national strategy for ICT in health.

While no country can implement a comprehensive national telehealth and health information programme a beginning can be made in priority areas that will lay the foundation for increased knowledge and understanding. Some of the strategies to achieve this would include:

- Creation of a national telehealth task force,
- Definition of priority application areas,
- Implementation, evaluation and monitoring of programmes.

A cross-governmental and interagency initiative could play a substantial coordinating role between components of local government. It could address key issues such as privacy, confidentiality, liability, data integrity, standards and nomenclature, education and universal access to infrastructure. The creation of national associations, task forces and the like, with multidisciplinary composition, is considered necessary to bring together telecommunication and health professionals, lawyers, industry and others to assist with awareness-raising at a national level. The task force would also carry out the following:

- Identify needs with the medical authorities and health professionals;
- Define priorities with health professionals;
- Decide how to organize the system to respond to the identified needs (by analysing the health system as it is now and showing how to improve it), and organize the telemedicine network (with telecommunication and health experts working together);
- Prepare a short and long-term plan of activities, budgets, etc.;
- Initiate pilot projects in the sustainable plan of activities to produce results in a very short time, in order to demonstrate the advantages of ICT applications in the health sector;
- Mount awareness raising seminars on regular basis
- Identify funding, advise government to fund/approach donors for funding, implement plans and ensure their follow-up and evaluation; and
- Assist in the creation of national websites to collect all relevant information relating to ICT applications in health with links to regional global information sources

At the sub-regional level, the emphasis should be on developing centres that design and implement ICT in health projects in key areas of medicine, promote public and professional education about the availability, selection, and optimal use of high-quality ICT applications and develop clearinghouses for public domain tools, materials, and information resources for ICT applications in health for public use. This presupposes:

- Creation of centres of excellence in telemedicine and telehealth;
- Networking among such centres; and
- Building gradually towards an African telehealth network.

At the regional level, there is a need for improved research, education and networking. More knowledge is needed to improve the effectiveness of information and communication technologies in the health sector, to inform application, design and implementation, and, ultimately to further develop an appropriate public policy for telehealth. Research, education and development are needed both within and beyond academic health centres and these must involve patients and practitioners beyond academia, as both informed contributors to and consumers of emerging systems. The development of national health data repositories, maintaining and assuring uniformity, confidentiality, and security of patient care data while providing access to appropriate users, standards and nomenclature for capturing medical knowledge, etc. all require ongoing research, learning and networking at the regional level. In addition there is a need for:

- Identifying and addressing current knowledge gaps and priority areas for basic and applied research, application development, and demonstration projects;
- Monitoring and assessing the health, economic, and social impacts of information and communication technology applications; and
- Monitoring and analysing trends in ICT policy development for the purpose of improving policy in ICT applications in health;

This cannot be established without a region-wide network and programmes in medical informatics. ECA, with WHO, should take the initiative to:

- Establish a consultative committee on African telehealth (as originally proposed for discussion at ADF 2000 – AIDS): the greatest leadership challenge; and
- Promote the establishment of medical informatics curricula in the region

IV. Conclusion

Information technology is increasingly applied in the health sector. Basic applications of information and communication technologies to the health sector include electronic medical records, hospital information systems, the setup of Intranets and secure Extranets via the Internet, and for sharing information among institutional and individual participants in health sector, the use of public networks such as Internet to distribute information, health decision-support expert systems, the provision of remote diagnostics via tele-medicine, and community health information system for local, regional and national health planning. Although the health sector is still far behind in applying new information technologies, recent developments in the Internet and WWW content have at least prompted the need for connectivity to exchange information on health in Africa.

The opportunities to be gained from investment in new information and communication technologies are wide and diverse. Investment in information and communication technologies in the health sector in Africa could complement basic health services provision. Opportunities include health administration enhancement, health sector connectivity, and decision support system for curative and preventive health improved distribution and reduced cost of medical supplies, etc.

However, these application of information and communication technologies in the health sector will continue to face challenges from weak infrastructure and resources and resistance due to lack of awareness. The barriers in regard to technology, regulatory frameworks, financial requirements and sociocultural issues need to be addressed. These challenges require a concerted national framework that pools knowledge together, sub-regional networks of centres of excellence and a regional coordination mechanism. It also demands the introduction of medical informatics to medical research institutions throughout Africa so as to build a corps of skilled champions that utilize new technologies, carry out ICT research based on local needs and act as evangelists of the new technologies. Assuring that the astonishing capabilities of information technology benefit human health to the fullest extent possible in the future is a growing challenge in Africa.

Annex 1

Applications to impact on HIV/AIDS – presented at ADF 2000

The AIDS pandemic is inextricably linked to the ability to obtain information that "can make a difference." ADF 2000¹ brought representatives from many constituencies of the AIDS epidemic to discuss their information need and expectations from new information and communication technologies. In addition to the constitution of an Africa telehealth network that brought major players in ICT for health together, the following regional mechanisms and initiatives involving four groups were proposed during ADF 2000 to exploit new technologies in the fight against HIV/ AIDS:

1. Telehealth Networks for Clinical Researchers and Healthcare Providers on HIV/AIDS

Researchers are confronted with dramatically increasing information base on HIV/AIDS while the general public's concern about the pandemic and continuous hunt for the latest information is mounting. Health providers including the medical, dental and nursing communities, need continuous information on treatments and special cases so as to adequately prepare to provide better care and protect communities and themselves. To date, the rate of information flow on HIV/AIDS in Africa is very low compared to the pandemic and advances in new information and communication technologies. Information flows through traditional channels such as personal contacts and photocopy clips from journals. A regional strategy that builds networks between clinical researchers and healthcare providers at national and regional level will be crucial to improve treatment and prevention of the pandemic.

2. Youth Information Network Against HIV/AIDS

Significant progress can be achieved through direct involvement of youth in information access and sharing on HIV/AIDS by networking them locally, nationally and regionally. Given the low level of access to ICTs by youth it could be difficult to reach all of them in a short term. However, it is possible to establish links to a few – through school networks and community telecentres - and gradually build nation-wide and region-wide youth networks. Interactive mass storage technologies such as CD-ROM and DVD could be used to fill the gaps in improving access to information and discussion by unconnected youth.

A comprehensive youth information networking and outreach package through ICT involving sourcing of ICT equipment for youth, packaging and delivery of information using mass storage and interactive technologies, facilitating online electronic forums among youth and youth groups would be important to manage

¹ ADF 2000-AIDS: The Greatest leadership challenge, 3-7 December 2000, Addis Abeba, Ethiopia
<http://www.uneca.org/adf2000/>

the further spread of the disease and build the capacity of youth to manage and resist it.

3. Knowledge base for African Government and African Media

African governments and media need a knowledge base on HIV/AIDS. African governments' decisions can be improved through reference to various national AIDS policies, studies on impacts of such policies, patient related information and issues, statistics, studies and research reports around the pandemic, strategies in areas of training and information handling. There is limited information on "what works in Africa" and "why it works." The public media also requires similar information to interpret and report to the general public. Maintaining such knowledge bases requires collecting large quantities of information and distilling extracts significant to policy makers and the media.

4. Forum and Networks for User Communities, Infected Individuals and Activists

Substantial progress in treatment and prevention of the AIDS can also be achieved through networking all the groups that have stakes in the pandemic. Online forums that involve patients, families, friends, advocates, activists, social workers, therapists, nutritionists, case managers, and others from all walks of life irrespective of location and setting would be critical to discuss diverse issues and exchange information to promote informed decisions at all levels. Many of these groups are generally isolated from each other and from information resources. An initiative that stimulates online discussion among these groups would foster solidarity and consensus in the fight against the disease and help devise strategies to deal with the growing challenges facing the region as a result of the pandemic.

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