

# TELEMEDICINE, THE EUROPEAN SPACE AGENCY AND THE SUPPORT TO THE AFRICAN POPULATION FOR INFECTIOUS DISEASE PROBLEMS

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## Abstract

Telemedicine and the broader field of eHealth as the application of Information and Communication Technology in the health sector offer opportunities for improving health world-wide. The European Space Agency (ESA) is since 1996 active in this field and has initiated various projects which have demonstrated that satellite communications is a powerful technology for enlarging the reach of Telemedicine services toward geographically isolated regions, especially those with a high burden of diseases, such as many areas in Sub-Saharan Africa. In 2006 the Telemedicine Task Force (TTF) with the mandate to explore the potential of Telemedicine via Satellite for this region has been established on initiative of ESA and the European Commission, with representatives of African stakeholders and the World Health Organization (WHO). After a review of the current situation, the TTF has recommended short-term pilot projects to demonstrate the feasibility of an approach based on user demands, public private partnerships, African ownership, and building on existing successful initiatives. These projects shall begin in 2008, serving selected isolated areas in Sub-Saharan Africa by offering clinical services and eLearning via satellite for infectious diseases, in particular HIV, tuberculosis, and malaria.

## 1 Introduction

Information and Communication Technology (ICT) offers a large variety of opportunities for world-wide advancements in health and healthcare. *eHealth* (the use of ICT in the health sector, for clinical, educational and administrative purposes, both locally and at a distance) and its sub-domain *Telemedicine* (the provision of healthcare services from a healthcare provider to a patient) are key enablers for supporting health systems and delivery of healthcare.

The second phase of the World Summit on the Information Society (WSIS) held in Tunis in 2005, adopted a Plan of Action that urges different stakeholders to contribute actively in utilizing ICT for the achievement of the Millennium Development Goals (MDGs) and for bridging the so called digital divide. Also in 2005, the World Health Assembly (WHA) passed a resolution urging countries to take advantage of the potential offered by eHealth to strengthen their health systems. In 2006, the WHA also requested World Health Organization (WHO) Member States, in another resolution, to use ICT to help address the global shortage of health workers. This health

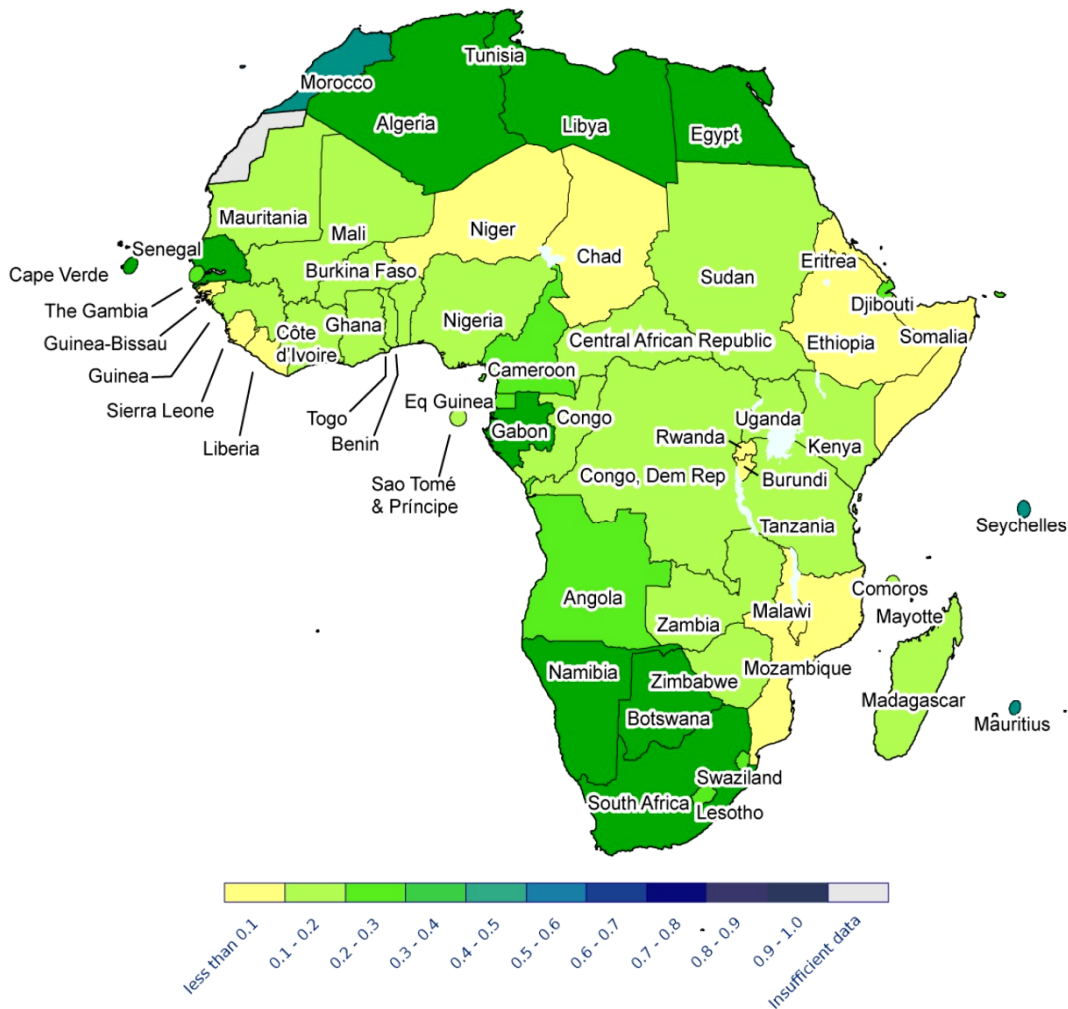
workforce crisis is particularly acute in Sub-Saharan Africa where thirty-six countries have a health worker density below a critical minimum necessary for effective provision of basic health services, and where in many countries the health service coverage (Table 1) and the readiness for information society (Figure 1) are critically low. With a broad range of possible applications in support of health service provision, communication, education, business, and governance, eHealth offers a significant number of opportunities to address this health crisis (TTF 2007).

Table 1: Health service coverage in Sub-Saharan Africa (WHO 2006 WHS) (TTF 2007)

Nr.	Country	Population	Immunization coverage among 1-year-olds			Antenatal care coverage			Births attended by skilled health personnel		Contraceptive prevalence rate	
			Measles	DTP3	HepB3	At least 1 visit	At least 4 visits	Year	(%)	Year	(%)	Year
			(millions) 2005	(%) 2004	(%) 2004	(%) 2004	(%)	(%)	Year	(%)	Year	(%)
1	Angola	15.9	64	59	...	...	...	47	2000	6.2	2001	
2	Benin	8.4	85	83	89	88	61	2001	66	2001	18.6	2001
3	Botswana	1.8	90	97	79	99	97	2001	94	2000	40.4	2000
4	Burkina Faso	13.2	78	88	...	72	18	2003	57	2003	13.8	2003
5	Burundi	7.5	75	74	83	93	79	2001	25	2000	15.7	2000
6	Cameroon	16.3	64	73	...	77	52	1998	62	2004	26.0	2004
7	Cape Verde	0.5	69	75	68	...	99	2001	89	1998	52.9	1998
8	Central African Rep.	4.0	35	40	...	...	...	44	2000	27.9	2000	
9	Chad	9.7	56	50	...	51	13	1997	14	2004	7.9	2000
10	Comoros	0.8	73	76	77	...	...	62	2000	25.7	2000	
11	Congo	4.0	65	67	...	...	...	...	...	...	...	...
12	Dem. Rep. of Congo	57.5	64	64	...	...	...	61	2001	31.4	2001	
13	Côte d'Ivoire	18.2	49	50	50	84	35	1998-99	63	2000	15.0	1998-99
14	Equatorial Guinea	0.5	51	33	...	...	37	2001	65	2000	...	...
15	Eritrea	4.4	84	83	83	...	49	2001	28	2002	8.0	2002
16	Ethiopia	77.4	71	80	...	27	10	2000	6	2000	8.1	2000
17	Gabon	1.4	55	38	...	94	63	2000	86	2000	32.7	2000
18	Gambia	1.5	90	92	90	92	...	2000	55	2000	9.6	2000
19	Ghana	22.1	83	80	80	90	69	2003	47	2003	25.2	2003
20	Guinea	9.4	73	69	...	74	48	1999	35	1999	6.2	1999
21	Guinea-Bissau	1.6	80	80	...	89	62	2001	35	2000	7.6	2000
22	Kenya	34.3	73	73	73	88	52	2003	42	2003	39.3	2003
23	Lesotho	1.8	70	78	67	91	88	2001	55	2004	30.4	2000
24	Liberia	3.3	42	31	...	...	84	2001	51	2000	...	...
25	Madagascar	18.6	59	61	61	91	38	1997	51	2003-04	27.1	2003-04
26	Malawi	12.9	80	89	89	94	55	2000	61	2002	30.6	2000
27	Mali	13.5	75	76	73	53	30	2001	41	2001	8.1	2001
28	Mauritania	3.1	64	70	...	63	16	2000-01	57	2001	8.0	2000-01
29	Mauritius	1.2	98	98	98	...	...	99	1998	...	...	...
30	Mozambique	19.8	77	72	72	71	41	1997	48	2003	16.5	2003
31	Namibia	2.0	70	81	...	85	69	2000	76	2000	43.9	2000
32	Niger	14.0	74	62	...	39	11	1998	16	2000	14.0	2000
33	Nigeria	131.5	35	25	...	61	47	2003	35	2003	12.6	2003
34	Rwanda	9.0	84	89	89	93	10	2001	31	2000	13.2	2000
35	Sao Tome and Principe	0.2	91	99	99	91	...	2000	79	2000	29.3	2000
36	Senegal	11.7	57	87	54	82	64	1999	58	2000	10.5	1999
37	Seychelles	0.1	99	99	99	...	...	...	...	...	...	...
38	Sierra Leone	5.5	64	61	...	82	68	2001	42	2000	4.3	2000
39	Somalia	8.2	40	30	...	...	32	2001	34	1999	...	...
40	South Africa	47.4	81	93	92	89	72	1998	84	1998	56.3	1998
41	Sudan	36.2	59	55	...	...	75	2001	...	...	...	...
42	Swaziland	1.0	70	83	78	...	...	70	2000	27.7	2000	
43	Tanzania	38.3	94	95	95	96	69	1999	46	2004-05	25.4	1999
44	Togo	6.1	70	71	...	78	46	1998	49	2000	25.7	2000
45	Uganda	28.8	91	87	87	92	40	2000-01	39	2000	22.8	2000-01
46	Zambia	11.7	84	80	...	94	71	2001-02	43	2001-02	34.2	2001-02
47	Zimbabwe	13.0	80	85	85	82	64	1999	73	1999	53.5	1999
48	Mayotte	0.2	...	...	...	...	...	...	...	...	...	...
	Total	749.86										
	Minimum		35	25	50	27	10		6		4.3	
	Maximum		99	99	99	99	99		99		56.3	
	Average		66	66								
	# Countries with ≥ 80%		16	21	14	22	4		5			
	# Countries with < 50%		5	6	0	2	17		21			

Despite the potential benefit of ICT for health world-wide, its utilization is in many countries still difficult or impossible, due to a lack of connectivity and network coverage, and other reasons such as for example illiteracy, regulatory, or cultural barriers. The prospect of using satellite

communications technologies and associated connectivity services to support the development and dissemination of Telemedicine and eHealth applications was the reason why ESA began to be active in this challenging field (Feliciani 2003). In 2006, efforts toward the support of Africa have been initiated by ESA in collaboration with the European Commission (EC), the WHO, and African stakeholders.



Note: The Index ranges between "0" and "1", where 1 would be complete digital opportunity.

Figure 1: Digital Opportunity Indices for Africa (ITU 2006 WISR)

## 2 ESA Telemedicine Projects

Several different projects have been undertaken within the Advanced Research in Telecommunication Systems (ARTES) programme to explore and promote the different facets of Telemedicine via satellite, taking a pragmatic approach, addressing broadband applications, medical simulation, emergency consultation, teleconsultation, clinical research, access to patient multimedia databases, and continuing medical education (Feliciani 2003). These projects have been targeted at developing the hardware, software and content elements required by the specific Telemedicine applications and then using the resulting system in a pilot utilisation phase with real users and under truly operational conditions.

An ESA Road Map for Telemedicine via Satellite was worked out in 2003 and 2004, identifying needs and opportunities for using ICT in specific areas of healthcare, and the role that satellite communications can play therein (ESA Telemed 2005). The Telemedicine areas studied included: interconnectivity for healthcare services, management of trauma, emergencies, and disasters, health early warning for environmental risks, eHealth education, healthcare at home, services for the citizens, and mobility. Strong involvement of health professionals in the process of defining this road map reflect ESA's strategy to complement initiatives mainly driven by industry and service operators with initiatives driven by demand.

More Telemedicine projects followed, in line with this new strategy. In 2005, the SIMONA project established the connection of a teaching hospital in Baghdad, Iraq, with the Hospital Umberto I of La Sapienza University in Rome, Italy, which helped by teleconsultations via video-conference e.g. in reducing childhood mortality. In the beginning of 2005, the project I-DISCARE has been initiated to support medical treatment of the victims along the coastal areas ravaged by the December 2004 tsunami in Asia, by connecting mobile teams of rescue workers with hospitals via satellite. The Satellite for Health Early Warning and for Epidemiology (SAFE) Telemedicine project has recently successfully completed a pilot run and demonstrated the feasibility of providing assistance via satellite, from remote locations, in the event of natural disasters and for post-crisis management.

### **3 Support to the African Population for Infectious Disease Problems**

A workshop held in Brussels in January 2006, sponsored by EC and ESA, focused on the potential of satellite telecommunication technology to strengthen health systems in Africa, recognising that given the current limitations of land based and mobile telecommunication, satellite technology could significantly extend the reach of communication to remote and isolated areas of the continent. A Telemedicine Task Force (TTF) was therefore set up with a mandate to develop a comprehensive picture of Telemedicine opportunities in Africa, focussing in particular on the Sub-Saharan region, and to formulate recommendations for future action. The TTF was composed of representatives from: the African Union Commission (AUC), the New Partnership for Africa's Development (NEPAD), the African Development Bank (AfDB), the Communauté Economique et Monétaire de l'Afrique Centrale (CEMAC), the Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale (OCEAC), the East African Community (EAC), the Economic Community of West African States (ECOWAS), the Secretariat of the African, Caribbean and Pacific Group of States (ACP Sec), WHO, EC, and ESA.

In its report the TTF stresses that among the world's regions, Sub-Saharan Africa, with its 47 countries and 750 million inhabitants (2005 figures), is the one with the highest burden of communicable diseases such as HIV/AIDS, tuberculosis, and malaria. The average life expectancy at birth in Sub-Saharan Africa was 46 in 2004. Health service coverage is low, as for example figures for immunisation coverage and the numbers of births attended by skilled personnel show. The region faces a serious health workforce crisis, due to the migration of doctors and nurses to more developed countries, and also due to the death of skilled personnel from disease (TTF 2007).

The TTF has reviewed health policies and strategies for African development of NEPAD, WHO and the European Union (EU). The review revealed that overall ICT penetration in most African countries is low, the availability of computers and, in particular, the internet access is extremely low. The TTF is convinced that by complementing terrestrial infrastructure with satellite communications, complete coverage of the African region can be achieved. In its report (TTF 2007) the TTF emphasises the important role of private public partnerships in the implementation of eHealth programs and projects in Africa, mentioning NEPAD eAfrica

Commission's e-Schools project as an excellent example. In this project five major consortia of private companies work in African countries with national industry and government partners to provide interconnectivity and ICT infrastructure to schools. The TTF has aligned itself with the health policies and strategies for African development of NEPAD, WHO and EU. These strategies all address the UN Millennium Development Goals (MDGs) and recognise ICT as an important enabler for progress towards these goals in the African region. Consequently, the TTF recommends a user and demand driven approach to support better access to information and knowledge for African health workers and citizens, based on well-delineated local needs and health priorities, laying emphasis on support to existing initiatives which address the needs of the stakeholders, by observing and harmonising related activities, promoting open markets, facilitating open systems, implementing demonstrators and proposing governance models and financial options.

#### **4 The Way Forward**

In the short-term the TTF proposes concrete action to demonstrate the feasibility of satellite technology to extend the reach of eHealth and to contribute to regional efforts to overcome health workforce shortages. Short-term actions include piloting the extension of existing programmes on eHealth. It is envisaged that this piloting process will permit an immediate start for using ICT in management and use of information and knowledge for improved health in Sub-Saharan Africa in order to demonstrate the potential benefits and to allow an estimation of the costs of effective use of the available technology.

Piloting activities shall begin in 2008. General requirements include: address highly relevant strategic goals; demonstrate a clear benefit in satisfying an urgent demand of African inhabitants; achieve strong African ownership; commitment of the stakeholders; innovative services, yet be based on existing and easy-to-use components; take advantage of successful service implementations, including infrastructure, governance models, and regulatory aspects; create a clear business plan ensuring a good chance for sustainability of the created services after initial funding. In order to reduce the risk of failure, special attention will be put on: the geographical choice of target areas, which shall build upon already existing mechanisms, e.g. used those used by NEPAD in their e-Schools project; the training of users and technicians in the isolated area, since it is crucial for a reliable operation of the communication facilities; the language issue; in order to keep it manageable, the piloting activities should not need the involvement of too many stakeholders; to ensure feasibility, they should not depend on complicated and/or failure-prone technical configurations; to address connectivity, not only one single country shall be served; no considerable amount of new content shall be created, since this is a time-consuming and costly task; the creation of a business case for migrating the project scenario into a sustainable service.

Both eLearning services and clinical services, targeted towards carefully chosen remote areas in Sub-Saharan Africa, can meet the criteria set up by the TTF. Therefore, two objectives shall be addressed:

1. *Offer continuing professional education via satellite to health workers in selected remote areas.* The target areas shall be chosen within different countries. They shall be isolated and suffer from a significant burden of disease. Though, there must be health workers on site who are able and willing to utilize ICTs for continuing education purposes. Existing medical content for doctors and nurses shall be chosen, preferably from African sources, paying special attention to its maintenance. Satellite-based access to the eContent shall be facilitated through different end-user devices, especially mobile devices. Low-cost,

easy to use components with low electricity consumption shall be combined to serve a broad range of application scenarios and to achieve good acceptance.

2. *Establish electronic communications between healthcare facilities in a few isolated areas with high burden of diseases and medical centres of excellence in Africa, for HIV/AIDS, tuberculosis, and malaria.* Implement a satellite-based clinical service to support health workers in diagnosing and treating these diseases. Medication follow-up, logistical and other types of support shall be given via communication services for speech, images, and sensor data. In addition to communication with centres of excellence, communication between inhabitants of the isolated areas shall be facilitated. The potential of using the service for providing telepharmacy functionality, which is highly relevant for the treatment of infectious diseases, shall be explored.

These piloting activities will be of particular interest to the EC in considering the potential expansion of eHealth as part of the EU Strategy for Africa objective of increasing interconnectivity, which will be taken forward under the 10<sup>th</sup> European Development Fund. All envisaged activities are, directly or indirectly, addressing the support for infectious disease problems, especially HIV/AIDS, tuberculosis, and malaria. The medical content and expertise shall preferably be provided by African centres of excellence.

## 5 Conclusion

There is still a long way to go in order to gain substantial contribution from Telemedicine and eHealth to the achievement of the MDGs. Therefore, based on earlier experiences and the lessons that will be learned from the piloting activities described, a programmatic framework shall be developed, outlining actions on a medium and long term scale, toward a sustainable eHealth infrastructure for the African continent.

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