

## ARTIGO

# *Technological Innovation and eHealth over the years: An International perspective*

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## INTRODUCTION

I am delighted by this opportunity to participate in the preparation of a Gold eBook to mark the 50<sup>th</sup> anniversary of the Pedro Ernesto University Hospital of the State University of Rio de Janeiro (UERJ) on August 26, 2012, through the Annual University Hospital Congress whose theme this year is “Technological Innovation on Health and Education”. Since the “Gold eBook” will cover both national (Brazilian) and international experience on Health and education, I will attempt to provide an international perspective.

It is particularly fitting that material for this paper is drawn from two addresses that I have given at important events, both held in Rio de Janeiro. The first was the 36<sup>th</sup> World Hospital Congress held in Barra de Tijuca in November 2009, and the second was the launch of the Global eHealth Ambassadors Program (GeHAP), of the International Society for Telemedicine and eHealth (ISfTeH), which took place at Federação das Indústrias do Estado de Rio de Janeiro (FIRJAN) in downtown Rio on November 11, 2011.

We begin with a historical account of one of the areas through which technological innovation has had a great influence on health – Telemedicine. UERJ's own Telemedicine Unit was started in 2008. But Telemedicine, from the Greek “tele” meaning at a distance, is as old as medicine itself. The earliest form of Telemedicine consisted of someone going to a healer, describing the symptoms of a patient too sick to travel to the healer, and then taking the recommended therapy back to the sick person. This age-old approach to telemedicine is still in use today in some remote areas.

Improvements in messaging and other communication technologies did not fundamentally modify the concept; they simply changed the modality. Thus, with increasing technological sophistication, messages between patient and care provider could be delivered remotely – by semaphores, Morse code, telex and more recently, by fax, email and the web. Among the most important factors in changing the character of telemedicine, though, has been the Internet, which has enabled entirely new types of telemedicine to emerge.

Hugo Gernsback, editor of *Radio News* in the April 1924 issue foreshadowed the potential impact of advances in telecommunication technology (radio, telegraph, telephone and television) on the practice of medicine, in the caption “The Radio Doctor – Maybe?” (see fig. 1)<sup>1</sup>



*Fig. 1: Cover of April 1924 issue of Radio News*

In 1968 Kenneth Bird coined the term “Telemedicine” to describe the provision of medical care to patients three miles away at the Logan International Airport Medical Station from the Massachusetts General Hospital in Boston. And the picture of a tele-homecare application in Canada in 2004 (shown in fig. 2) is not too far from Gersback’s vision.



*Fig. 2: A Canadian Telecare project (Credits. March Networks Corporation)*

In between Gernback's vision and the Telemedicine application of fig. 2, there have been a number of landmark advances in science and technology to help realize the dream. In 1946, Jon von Neumann proposed the von Neumann architecture of a general purpose stored program digital computer, a universal Turing machine. His architecture also had the elegance of using numbers to represent instructions, thus resulting in a single storage unit for both data and instructions<sup>2</sup>. William Shockley, John Bardeen and Walter Brattain invented the transistor in late 1947, which led to the replacement of the vacuum tube with solid state devices, which were more reliable, consumed less power and took up less space.

In September 1958 the first integrated circuit was demonstrated, invented at Texas Instruments by Jack Kilby<sup>3</sup>, and six months later independently by Robert Noyce, working at Fairchild Semiconductor, who later founded Intel, together with Gordon Moore. This enabled the miniaturization of computing and other electronic equipment. Kilby was ultimately recognized for his contributions with the Nobel Prize for Physics in 2000.

A seminal event occurred in April 1995. An SOS email message was sent through the Internet requesting international help for a young female Chinese university student, suffering from an unknown but severe disease. This led to the first recorded Internet diagnosis – of Zhu Lingling, with Guillian-Barre syndrome<sup>4</sup>. Today, we can routinely send imaging studies through the Internet, and carry out live demonstrations and remote consultations through videoconferencing.

Another landmark event had occurred two years earlier. This was the integration of various media into a single system around a computer - computers with telecommunication, videoconferencing with real time data transfer, on

May 23, 1993 when “a cult movie entitled *Wax: Or the Discovery of Television Among the Bees* was broadcast over the Internet [5]. This event demonstrated the use of the computer as an all-purpose communications device combining the functions of a telephone, television, email, text, video clips, still images, and audio.

It is interesting to note that these developments have had little to do directly with medicine. However, they have had a profound effect on medicine and health, thus underscoring the premise of the WHO Commission on the Social Determinants of Health, when it emphasizes in its final report the need to:

1. Improve the conditions of daily life – the circumstances in which people are born, grow, live, work, and age;
2. Tackle the inequitable distribution of power, money, and resources – the structural drivers of those conditions of daily life – globally, nationally, and locally<sup>6</sup>.

### *WHY eHEALTH?*

In 2005, when I was at the World Health Organization (WHO) and responsible for eHealth, we struggled over the definition of the term “eHealth”. There were fifty-one published definitions of it in the literature at the time<sup>7</sup>. So, we came up with a formal definition, but also an operational one of eHealth as “ICT for health” or the use of ICT in health, which captured the essence of all the varying definitions.

eHealth can make a world of difference in all countries - rich and poor, in industrialized countries as well as developing countries. Let us see why eHealth is important. Fig. 3 is a scatter plot of countries the world over showing per



capita health spending on the y-axis vs gross domestic product per capita on the x-axis, on a log-log scale. It is easy to observe the very strong correlation – R-squared of 0.94 – between the two variables<sup>8</sup>. What this says is that by and large, how much a country spends on health depends on the strength of its economy as measured by per capita GDG. It makes intuitive sense. Countries spend on health in proportion to what their economies produce.

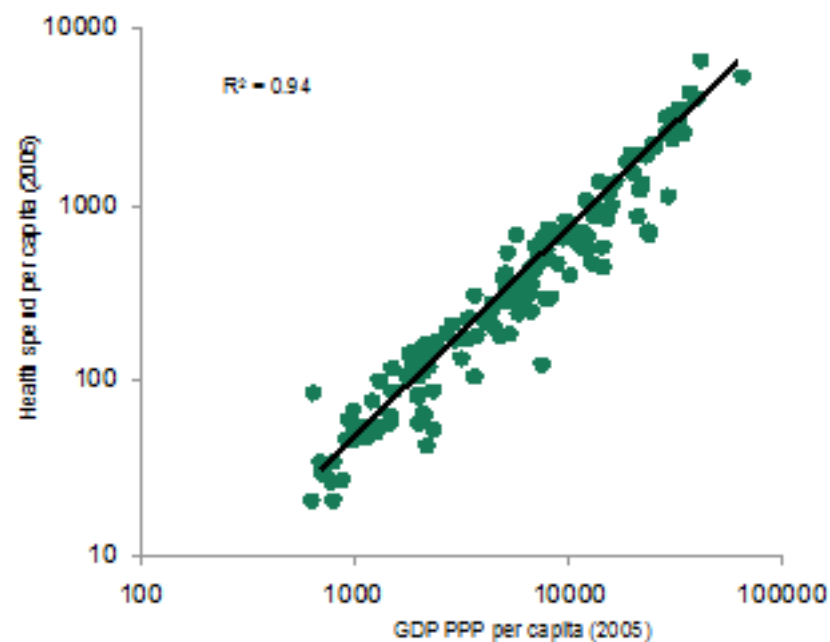


Fig. 3: Scatter plot of health spending per capita (y-axis) vs GDP per capita (x-axis)  
Source: Nicholas C. Petris Center on Health Care Markets & Consumer Welfare (UC Berkeley), WHO, *A Handbook of Cultural Economics* (James Heilbrun).

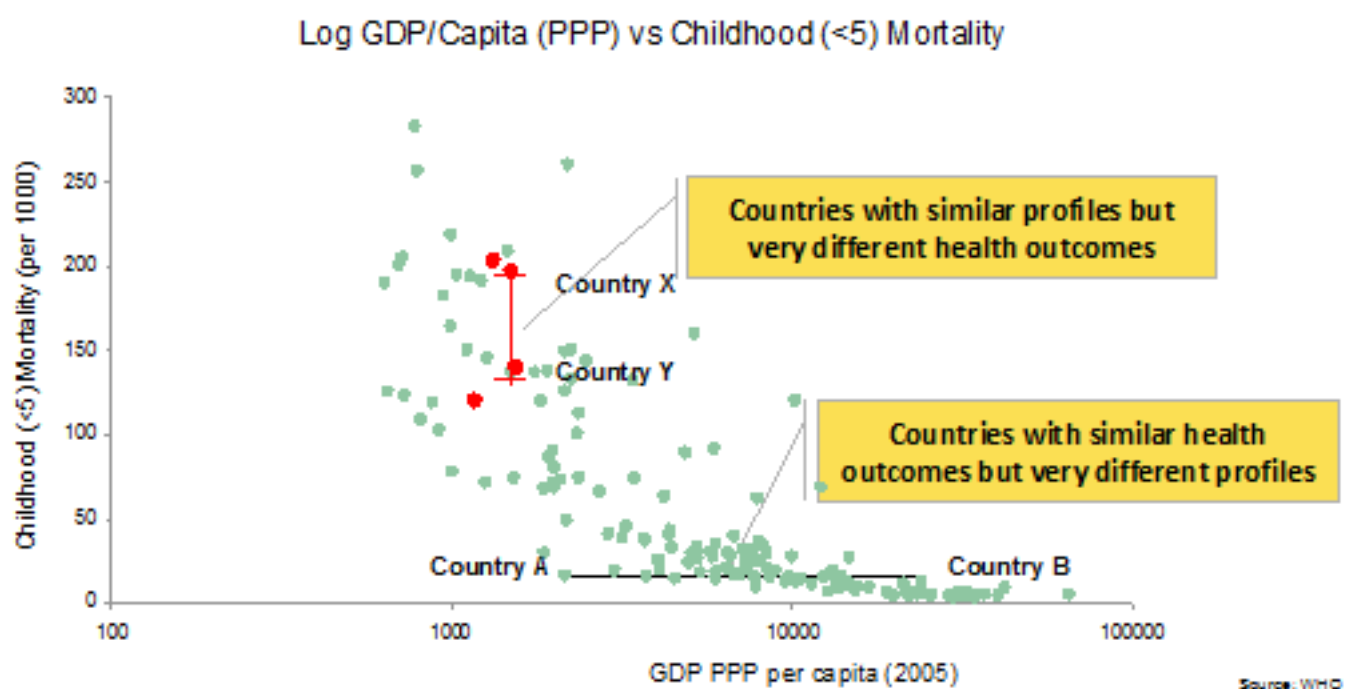


Fig. 4: Scatter plot of U5 mortality (y-axis) vs GDP per capita (x-axis)  
Source: Nicholas C. Petris Center on Health Care Markets & Consumer Welfare (UC Berkeley), WHO, *A Handbook of Cultural Economics* (James Heilbrun).

However, spending on health does not directly translate into health benefits as measured by any number of indicators. Fig. 4 shows a plot of one key indicator, Under 5 mortality, on the y-axis vs GDP per capita, which as we have seen is a proxy for health spending, on the x-axis. Notice the case of two countries X and Y, with the same spending profile but with outcome figures which differ by 60 points. Also notice two countries, A and B, which have the same outcome levels, but one country spends ten times as much per capita as the other.

William Baumol, an economist in the sixties postulated that in a labor-intensive sector such as health, capital does not readily translate into labor. However, two activities which can improve the productivity of the health system are, technology and good management, both of which can be greatly enabled by ICT.

### *MAJOR POLICY DECLARATIONS ON ICT AND HEALTH IN THE FIRST DECADE OF THE 21<sup>st</sup> CENTURY*

Recognizing the value of technology in health, there were a number of global declarations on the subject between the years 2000 and 2005. The first of these were the Millennium Development Goals, three of which are directly concerned with health (MDGs, 4,5 and 6). A fourth, MDG 8 on partnerships, specifically addresses ICT in its Target 8f, which states: “In cooperation with the private sector, make available the benefits of new technologies, especially information and communications”.

The next global declaration in chronological sequence was Resolution 41 on “eHealth including Telehealth/Telemedicine” at the 2002 World Telecommunication Development Conference in Istanbul, Turkey<sup>9</sup>. It mandated that

the Bureau of Telecommunications Development of the International Telecommunications Union (ITU), *inter alia*, to:

- Encourage collaboration, and provide support using TELECOM surplus funds and other resources, on eHealth projects on the national and regional level;
- Set up, within existing budgetary resources, a fund for telecommunication facilities for e-health, and introduce e-health training in the centers of excellence;
- Promote, facilitate and provide technical support and training in information and communication technologies for e-health;
- Work with the health sector to identify models for sustainability of e-health applications, particularly in remote and rural areas of developing countries, exploring possibilities for sharing infrastructure with other services and applications.

The World Summit on the Information Society (WSIS) Phase 1 held in Geneva (2003) and Phase 2 in Tunis (2005), took up the theme in Action plan C7, which proposed areas of ICT applications to benefit all aspects of life: i) eGovernment; ii) eHealth; iii) eBusiness; iv) eEnvironment, and others.

Perhaps the most far-reaching of the declarations, in terms of its impact on bringing technology to support health, has been the World Health Assembly resolution, passed in May 2005. Resolution WHA58\_28 calls on Member States to carry out a number of activities in the area of eHealth, including: drawing up long-term strategic plans for developing and implementing eHealth services; development of infrastructure for ICT; closer collaboration with the private and non-profit sectors in ICT; reaching communities, including vulnerable groups, with eHealth services appropriate to their needs; mobilizing multi-sectoral collaboration for determining evidence-based eHealth standards



and norms; evaluating eHealth activities, and sharing the knowledge of cost-effective models; establishing national centers and networks of excellence for eHealth best practice, policy coordination, and technical support; establishing and implementing national electronic public-health information systems. The resolution further requests WHO, inter alia: to provide technical support to Member States in relation to eHealth products and services by disseminating widely experiences and best practices, devising assessment methodologies, promoting research and development, and furthering the development and use of eHealth norms and standards<sup>10</sup>.

### *eHEALTH AND HOSPITALS*

Since we are celebrating the 50<sup>th</sup> anniversary of a hospital, we would be remiss not to make specific mention of the role of ICT in hospitals. The power ICT to transform health systems is increasingly undisputed. Hospitals are one of the major institutions of the health sector that are being transformed. In an article for the International Hospital Federation (IHF) reference book in 2008, I said the following, which bears repeating on this occasion<sup>11</sup>.

Hospitals and hospital associations need to be aware of, prepare for, and properly manage, this transformation. It will change, forever, the role of hospitals in the business of producing health. It will make them more efficient, improve quality and strengthen processes. But it will also remove them as the centerpiece of the health care system, and give hospitals a more forward-looking and progressive role. There are those who will see this as a loss for hospitals. We hope they are in the minority. For, what is more important for hospitals - a central role in a disease model of health care that unwittingly fosters huge disparities and is likely to bankrupt the system, or a key peripheral

role in a higher quality, more equitable, and more sustainable health system?

Three examples of how eHealth does this, from potentially many more, were given. First, providing access to services which were hitherto unavailable to patients, because eHealth tools allow practitioners to offer services beyond their physical reach. Secondly, decisions are made everyday in hospitals – clinical decisions about patients (diagnosis, options for therapy); staff; about research; administration and finance, and a host of other aspects of health. Decision support systems and access to remote expertise help people make better-informed decisions. Thirdly, eHealth is facilitating, on a systemic level, the translation from records of individual care to knowledge about the health of populations.

However, eHealth can be a double-edged sword. To benefit from it, health institutions, which already feel stretched for resources, will have to develop the capacity to use this great enabler. But it is precisely for the same reason – limited resources – that hospitals must invest in human and institutional capacity to leverage the power of ICT, to increase their productivity, through efficiency gains.

The existence of the Telemedicine Unit of the Pedro Ernesto University Hospital, is a clear statement that UERJ recognizes the value that ICT can bring to the work of its teaching hospital.

### *PEOPLE – THE KEY TO INNOVATION IN eHEALTH*

The eHealth revolution is predicated on the trinity of people, processes and technology. People are the key, because although technology and processes can change people, the greater influence pathways are those of people changing processes and technology – through inventiveness, innovation and creativity. The changes that can transform health systems come through the creative genius of people.

### *Empowering citizens with information and knowledge*

eHealth is also transforming the role of citizen in health care, by enabling citizens to access health information and therefore make the transition from passive observers in the care process to active participants. And in some cases, patients will arrive at the hospital armed with more information on their condition than the health professional.

### *Equity and social justice in health*

Society faces a serious challenge of health equity and social justice around the world. If you pause for ten seconds, it is sad to think that during these ten seconds, when the sprinter, Usain Bolt, would have run 100 meters and been on his victory lap, three children around the world would have died. In another fifty seconds one woman would die of complications from childbirth. On the 12<sup>th</sup> of August 2012, as we celebrate the 50<sup>th</sup> anniversary of the Pedro Ernesto University Hospital, it is estimated that approximately 30,000 children will die, two thirds of them from preventable causes – causes for which there are known effective and affordable interventions. What can ICT do to change this, being mindful that the study of technology trends points to the fact that while technology improves average levels, it also tends to increase inequalities due to differences in adoption rates for technology by various income groups? We think that ICT can help. And that is why Nobel Peace Prize Laureate Archbishop Emeritus Desmond Tutu serves Chair of the Global eHealth Ambassadors Program (GeHAP) of the International Society for Telemedicine and eHealth (ISfTeH). He believes “*eHealth gives us the best means of providing accessible health care to the poorest and most vulnerable*”.

The website the Society ([www.isfteh.org](http://www.isfteh.org)) describes the GeHAP more completely.

## *Human resources for health*

Consider, one aspect of this – the health work force. A key component of the capacity to leverage eHealth, and one of the areas of greatest need, is that of human resources for health. Many health systems in developing countries are in danger of not meeting the health MDGs because they lack the workforce to provide even basic services. Hospitals, with their need for highly trained workers, are at the forefront of this challenge. In 2006, WHO reported that there was a global shortage of over 4 million health workers<sup>12</sup>. In 56 countries around the world, 33 of them in Africa, the ratio of doctors, nurses, midwives and pharmacists to the population was below a critical minimum considered essential for delivering basic services. Without sufficient health workers these countries are in danger of not meeting the health MDG targets.

On the other hand, ICT-mediated forms of educational delivery, such as eLearning, can help train health workers, of high quality and in sufficient numbers – on the job – without them being lost to services during the training, or, worse, lost to the brain drain phenomenon when they are trained abroad. Good examples include Brazil's PROFAE initiative where the skills of 323,000 nurse auxiliaries were upgraded in just 18 months<sup>1</sup>. Similarly Kenya is upgrading 22,000 nurses to become registered nurses in about five years. Using traditional methods of educational delivery and given the country's current training capacity it would cost ten times as much and take over 150 years to train that many nurses. The Seychelles in 2006 produced its first cohort of graduate nurses without a bricks-and-mortar nursing school. It did so through ICT-mediated distance learning in collaboration with the Indira Gandhi National University in India.

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<sup>1</sup> See, for example, <http://www.iadb.org/en/news/webstories/2006-04-13/national-training-program-revamps-the-nursing-profession-in-brazil,3009.html>

### *Decision support systems*

ICT has become indispensable in health, as the volume and complexity of knowledge and information have outstripped the ability of health professionals to function optimally without the support of information management tools. Daniel Masys made the following statement in 2001. “Current practice depends upon the clinical decision making capacity and reliability of autonomous individual practitioners for classes of problems that routinely exceed the bounds of unaided human cognition.”<sup>13</sup> In the area of health research, for instance, the sheer volume of new information is enough to stretch even ICT-assisted decision-making systems. On an average day, in the middle of the last decade (2000 – 2009), there were 55 new clinical trials, 1,260 articles indexed in MEDLINE, and 5,000 papers were published in the biomedical sciences <sup>14</sup>. How can we expect to keep pace with this exponential growth in health information and knowledge without support of eHealth tools?

### *PARTNERSHIP*

But countries may have a difficult time going it alone. As Eysenback puts it, eHealth lies at the intersection of medical informatics, public health and business, and in a broader sense characterizes “a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.”<sup>15</sup> There is a need for a global eHealth partnership. What is needed is not a new, formal, legal entity that is likely to be unwieldy and introduce its own challenges in terms of governance, funding, management, sphere of influence, etc. What is required is a loosely-coupled arrangement whereby existing organizations agree to work collaboratively on eHealth matters. The International Hospital Federation,



for example, along with its member associations, could engage in this type of partnership.

Another useful type of eHealth partnership derives from the fact that groups of countries with common historical ties, and who cooperate in many development areas, would find great value in incorporating an eHealth dimension into their interactions and transactions. This is already happening in the European Union through the common eHealth ERA. This involves eHealth not as a stand-alone activity, but eHealth woven into the fabric of other health sector activities. A smaller example, but no less significant, is the Community of Portuguese-speaking countries (CPLP), whose health ministers have endorsed WHO's ePORTUGUESe initiative as a key instrument to achieving their collective goals in health. Similarly, Commonwealth health ministers, on May 19, 2008, mandated the Commonwealth Secretariat to develop a common eHealth program for its member states. The same joint program could be envisioned for La Francophonie (the commonwealth of French-speaking countries) and the Organization of the Islamic conference, with its fifty-six member states, the largest intergovernmental organization outside the United Nations system.

### *THE INTERNATIONAL SOCIETY FOR TELEMEDICINE AND eHEALTH (ISfTeH)*

At the civil society level, such collaboration is being promoted by the International Society for Telemedicine and eHealth. As its history shows, the very existence of the Society was driven by a search for collaboration. The seed of the International Society for Telemedicine was planted at the First International Conference on the Medical Aspects of Telemedicine, held in Tromsø, Norway in 1993. A group of experts at the meeting met to discuss the possibility of forming an international society. The field was as yet in

its infancy, and, owing to the varied interests and contrasting ideas of the participants, agreement on a course of action could not be reached and the proposal was unsuccessful.

A second attempt was made at the Second conference, held at the Mayo Clinic in 1995 in conjunction with the 2nd Mayo Telemedicine Symposium. Similar problems arose, and the proposal was again unsuccessful.

Third time lucky. The Third International Conference on the Medical Aspects of Telemedicine was held in Kobe, Japan in May 1997. In the lead up to the meeting, the Secretary embarked on an aggressive plan to found a society. Telemedicine luminaries from around the world were recruited to join a Founder's Committee, many of whom were able to attend the conference. The Committee also included the members of the conference's Japanese organizing committee.

The meetings were held over two days. Discussion was spirited as each of the thirty participants sought to establish their view on what all sensed was an groundbreaking occasion. About halfway through the first meeting it seemed history would repeat itself, with the predominance of a particular view that sought to see the new group founded along political lines. A deadlock ensued. Finally, as the meeting approached its scheduled conclusion, relief came in the form of a particularly impassioned speech, so cleverly crafted and forcefully delivered that none dared contradict it. The meeting chairman, a canny veteran of a dozen similar battles, seized the moment and forced the vote. The motion was carried - the International Society for Telemedicine was formed along the lines its original promoters had sought. Officers were empanelled and the future was mapped out.

Subsequent activity focused on development of the biannual conferences, The host country for the first conference of the new society was Jerusalem, Israel, as the Fourth International Conference on the Medical Aspects of Telemedicine. At that meeting the decision was made to hold the conferences

on annual basis. The Fifth Conference was held in 2000 in Montreal, Canada, the Sixth in 2001 in Uppsala, Sweden, the Seventh in Regensburg, Germany. The Eighth Conference, in 2003, fittingly returned on the 10<sup>th</sup> anniversary of the First to the place of its founding, to Tromsø, Norway. The meetings were all very well attended and admirably served the purpose of the International Society for Telemedicine in furthering the knowledge about telemedicine.

In the run-up to the Regensburg meeting, the decision was made that the International Society for Telemedicine needed to be reformulated. Although the meetings had been greatly successful, the society had found it difficult to fulfill its other goals, and so a new way forward was sought. After discussion at Regensburg, it was decided to re-establish the Society more along the lines of a federation of national bodies. The decision was endorsed and in September 15<sup>th</sup>, 2003 'ISfT 2' was officially established as a not-for-profit organization under Swiss law.

Newly invigorated and with new purpose, the new International Society for Telemedicine looks set to fulfill all of the Society's original goals, and many more.

The ISfTeH currently brings together national professional associations in 41 countries and with institutional memberships (hospitals, laboratories, schools, training and research establishments) in an additional 30 countries. Its mission is "to facilitate the international dissemination of knowledge and experience in Telemedicine and eHealth and to provide access to recognized experts in the field worldwide."<sup>16</sup>

It is arguably the key professional body in the field of telemedicine and eHealth in the world. In recognition of its potential to support eHealth worldwide, the Executive Board of the World Health Organization at its 122<sup>nd</sup> session in January 2008 admitted the ISfTeH into official relations with WHO. Formal relations also exist between the ISfTeH and the following other organizations and bodies in the United Nations system: the International

Telecommunication Union (ITU); where the Society is active in ITU-D Study Group 2 - Question 14 - Telecommunications for e-Health; the European Commission (DG INFSO – Brussels, and DG SANCO – Luxembourg); the United Nations Office for Outer Space Affairs, Vienna; the UNESCO World Academy of Biomedical Sciences and Technologies, Paris. The ISfTeH is currently managing a feasibility study for a global eHealth convention, funded by the Rockefeller Foundation. The Society's network is a crucial asset for disseminating best eHealth practices through its annual rotating conference, its fixed event Med-e-Tel, held in Luxembourg every year and the Med-e-Tel Newsletter (distribution list of nearly twenty thousand), and including links to the WHO eHealth Intelligence Report (eHIR).

### *Key partners*

WHO, as the steward of international health, is a natural focus for eHealth collaboration. But it is also clear that the Organization does not have the capacity and resources to do all the convening. In the past, when working exclusively with government institutions in the South proved ineffective, a shift to working with NGOs led to improvements. WHO has therefore identified two international NGOs with which it has a privileged relationship in the eHealth arena – the International Society for Telemedicine and eHealth, and the International Medical Informatics Association. Together they serve as surrogate convenors, and with their membership could form the nexus of a global partnership for eHealth. Industry, clearly is also major player in the eHealth field. , and collaboratives such as the Continua Alliance, which is driving the development of interoperable products for home care are to be encouraged.

### *Making the eHealth connection - a Rockefeller Foundation initiative*

The Rockefeller Foundation has also been instrumental in promoting collaboration in eHealth and forging partnerships in the field. Following the Pocantico II meeting in September 2007, the Rockefeller Foundation identified the challenge of weak health systems as one of five major issues to frame its future investments. One leg of the health systems work is eHealth. To pursue this further, the Foundation convened a series of Bellagio meetings in order to “collectively take stock of the current state of the different thematic areas of eHealth, work on agenda-setting, identify leverage points and next steps, .” The Making the eHealth connection website site ([www.ehealth-connection.org](http://www.ehealth-connection.org)) - is a rich source of the latest information on eHealth in the “Global South” - low and middle income countries. Issues, challenges, opportunities, best practices, practices to be avoided; video clips; contact information for leading minds in the field; even collections of “eHealth songs” are available on the site. A visit there is a must for those who wish to delve further into eHealth in developing countries. The Foundation played a key role in the creation of the mHealth Alliance in 2009 in Barcelona.

### *A FRAMEWORK FOR ORGANIZATION OF EHEALTH IN COUNTRIES*

For eHealth to take root and grow in countries and for the WHO priority actions to be the most productive, eHealth itself needs to be transformed from the passion of a select few, to a mainstream activity of the entire health system. We must weave ICT into the fabric of the health system. We must also advance from individual pilot projects to fully scaled up and coordinated programs, in telemedicine, eLearning, electronic health records, health promotion, etc. This requires a vision, and a roadmap – usually embodied in a national eHealth strategy. Hence due emphasis and importance must be given to the development of national strategies.



How do we ensure this eHealth internal transformation takes place? First let's look at the eHealth revolution. It is predicated on the trinity of people, processes and technology. People are the key, because although technology and processes can change people, the greater influence pathways are those of people changing processes and technology - through inventiveness, innovation, creativity.

To support the internal transformation, the practice of eHealth needs to be organized. In many countries it currently is not. Global eHealth Consultants, together with the International Society for Telemedicine and eHealth has identified five main institutions which not only need to exist, but must work closely together for the organized profession to thrive and positively impact the health system.<sup>17</sup>

1. National eHealth Council – an instrument for policy advice to the Government on eHealth matters. It should include all major stakeholder groups in the country, but remain a government sponsored organ.

2. eHealth Corps – a nationally recognized professional corps of eHealth experts within the Health authority, with full post descriptions and a scheme of service, so that eHealth experts can envision careers in the health system of the country. Beyond clinicians, there is a critical need for technical staff, who are competent in eHealth, to help bring ICT to bear positively on health system challenges. Yet, the need for eHealth expertise often is not part of the human resources for health calculus in many countries. It is the professionals who provide not only skills to keep systems running - from supply chain logistics to maintenance and repair of hardware and software systems. It is they who can articulate country needs in terms of development of technical staff for the health system; projections of future needs, curriculum for education and training institutions to produce the requisite numbers and quality of eHealth workers. Investments are needed to target the creation of a corps of eHealth

experts in each country. Professional associations are key to building and retaining such a corps.

3. eHealth Steering Committee – an eHealth steering committee in each country should advise the national health authority on setting eHealth policy and determine strategic direction. It should also oversee all eHealth projects and programs in the country and be responsible for their efficient coordination.

4. National Center/Network of Excellence for eHealth – A national center of excellence for eHealth policy coordination, and technical support for health services, as recommended by the World Health Assembly resolution on eHealth (WHA58.28). Preferably, this should be a network of centers.

5. National eHealth professional society – a national professional association; affiliated with international organizations such as the International Society for Telemedicine and eHealth, and or the International Medical Informatics Association (IMIA), to provide links to other professionals outside the country for sharing experiences, to mutual advantage. National societies, serve as stewards of the profession and guarantors of quality in the work of their members. They thus have a key role to play.

### *Scale effects*

Benefiting from modern-day peer production and co-production phenomena spurred by the Internet, social networking, contrary to the connotation, is increasingly used to boost productivity in the workplace. Such phenomena are greatly enhanced by scale effects. It is the difference in the internal dynamics of a community when only a handful of people have phones, compared to when the majority of community members are connected. The organic growth of relationships through such interactions is greatly facilitated when professionals are organized.

The National Health Service's (NHS) Connecting for Health in the United Kingdom, has taught us at least two lessons. One is the power of going to scale. Before this program, the NHS spent millions of pounds every year on eHealth over long periods but with no significant impact. The investments were not commensurate with the magnitude of the problem. With huge investments, in the tens of billions of pounds, positive results are being seen - NHS direct (telephone call-in service); Choose-and-book; PACS, to name just these.

Across the Atlantic, the Canada Health Infoway has demonstrated the power of interoperability. This large-scale effort, and other smaller ones such as the OpenMRS, OpenEHR movements, etc. have led to the call for integrated eHealth systems as the overarching theme for global eHealth efforts. Health facilities in developing countries stand to benefit by adhering to this theme.

Following the classic diffusion curve for technology, eHealth needs to accelerate beyond champions and early adopters to the early majority. An organized profession would even bring in the late majority.

### *Sustainability*

Another key advantage of adopting such a framework, which seeks to integrate eHealth into the health system fabric, is its positive influence on sustainability of eHealth projects. Sustainability is now routinely used to augment quality, access, cost and cost effectiveness, beneficiary perceptions, and provider perceptions (elements of the classic IOM model for assessment of ICT in health) to become the sixth dimension for assessment. It is the considered view of more and more observers that mainstreaming eHealth is the most promising mechanism for ensuring its sustainability – in other words, let eHealth sink or swim with the health system. So, if we weave it inextricably into the health system, eHealth will remain as long as the health system exists.

And should the health system fail to exist, eHealth would have no purpose anyway, so nothing would be lost.

### *Functions of the structures – building capacity for eHealth*

Organized eHealth professionals can carry out a number of functions that are indispensable to further development of the use of ICT in the health sector of the country. Key among these are:

- advocacy, articulating ethical and evidence-based policies for the use of ICT in the health sector; and
- building national capacity for eHealth by supporting the development of:
  - eHealth experts;
  - health providers capable of harnessing the power of ICT to improve their work (ePractitioners); and
  - eHealth literate citizens – better informed consumers of health services, who are thus transformed from passive observers to active participants in the therapy process; and
- developing the evidence base on eHealth – what works, why and under what conditions, and ensuring the sharing and reapplication of this knowledge widely.

### *HEALTH INFORMATION FOR THE PUBLIC*

The citizen is a major and sometimes, some would say often, neglected resource in the health system. The ecology of medical care shows that in a given month, as many as 20% of those served by the health care system show no signs of illness<sup>18</sup>. Investments in prevention would reap significant benefit in heading off greater expenses in providing care to the sick. Recent evidence points to preventive health as the primary domain of improvement from the

use of information technology in health, and decreased utilization of care as the major efficiency benefit realized.

Already the citizen is mutating from a passive participant in the care giving process –constrained by the information asymmetry between provider and patient that was part of the culture for so long – to an active partner in the healing and wellness processes. Today patients might have more information on their conditions than the doctor, although they still need the health care professional to translate that information into meaningful action. The fact remains that an informed patient is an asset in the therapy process.

### *Avoidable mortality*

According to projections carried out by WHO and published in early 2006, the world will experience a substantial shift in the distribution of deaths from younger age groups to older age groups, and from communicable diseases to noncommunicable diseases.

The four leading causes of death globally in 2030 are projected to be ischemic heart disease, cerebrovascular disease (stroke), HIV/AIDS and chronic obstructive pulmonary disease. The total number of tobacco-attributable deaths is projected to rise from 5.4 million in 2005 to 6.4 million in 2015 and to 8.3 million in 2030. Tobacco is projected to kill 50% more people in 2015 than HIV/AIDS and to be responsible for 10% of all deaths. The top four conditions are either avoidable or remediable through lifestyle modification. Personalized knowledge about these risk factors, whether they are genetic predisposition to certain conditions or lifestyle and environment-induced risks, is either available or can be generated. from we can predict these.

If we arm the citizen with information and knowledge the health system will transform itself. Consider, for example, how much worse the AIDS pandemic would be without health information, education and communication (IEC) campaigns.



## *HEALTH AS A PRODUCTION FUNCTION*

However, eHealth is far from being a panacea for all that ails health systems around the world. As with any technology, it is important to recognize its limitations, even as we work to overcome them. Many factors influence health status and a country's ability to provide quality health services for its people. Ministries of health are important actors, but so are other government departments, donor organizations, civil society groups and communities themselves.

Current eHealth efforts have focused heavily on contributing to improved health through supporting health care interventions. This is understandable, given the added value of ICT in health care delivery processes, and the large share of the health system dollar spent on care. However, this narrow focus ignores the other significant influence pathways to improved health. A constant refrain in the arguments against investing in eHealth in developing countries is the fact that basic needs - water and sanitation, housing and shelter, food and nutrition, basic education - are not met in many resource-challenged health systems. The eHealth community needs to examine how ICT can contribute to these other determinants of health.

While we delve more deeply into traditional areas of ICT application in health let us think creatively about other ways in which this "great enabler" can contribute to strengthening health systems in countries and thus to improved health. Let us look at the determinants of health and see where else we can bring ICT to bear positively on the influence pathways to better health.

We know that a production function for health would necessarily include: a) water and sanitation; b) food and nutrition; c) housing and shelter; d) education; as well as e) health care. Current eHealth efforts have focused heavily on contributing to improved health through supporting health care interventions. There is a need to examine other pathways to health and how ICT can

improve their effectiveness At the very least we need to invest more effort to examine how ICT can help reduce health inequalities.

A few examples: nano-filters in are being used in Bangladesh for removing pollutants and ensuring that water is safe to drink. Similarly, nano-sensors are for monitoring water quality at reduced cost, as well as nano-membranes in the treatment of wastewater.

Sensor technologies for monitor vulnerable environments and prevent or limit natural disasters. In general sensors exist today for water quality, air quality, weather, soil moisture, leaf wetness, biotelemetry, video (web cam), and others. Extensive and effective systems can be deployed to ensure early warning and evacuation, thereby reducing loss of life due to natural disasters. Special robots are now available for mine detection to save lives and limbs in conflict and post-conflict zones.<sup>19</sup>

And investments in eHealth should not only be in response to existing challenges, but as a proactive measure to ward off the challenges of tomorrow, and indeed prepare a brighter future for coming generations. Health is at the center of all human development, and the future of health is inevitably tied to information and communication technologies.

## *THE FUTURE*

### *People*

Perhaps the most notable attribute of eHealth is that it is enabling the transformation of the health system: from one that is narrowly focused on curing diseases in hospitals by health professionals, to a system with a broader emphasis on health and empowering citizens by providing them with information to take care of their health whenever the need arises, and wherever they may be.

## *The mobile phone revolution*

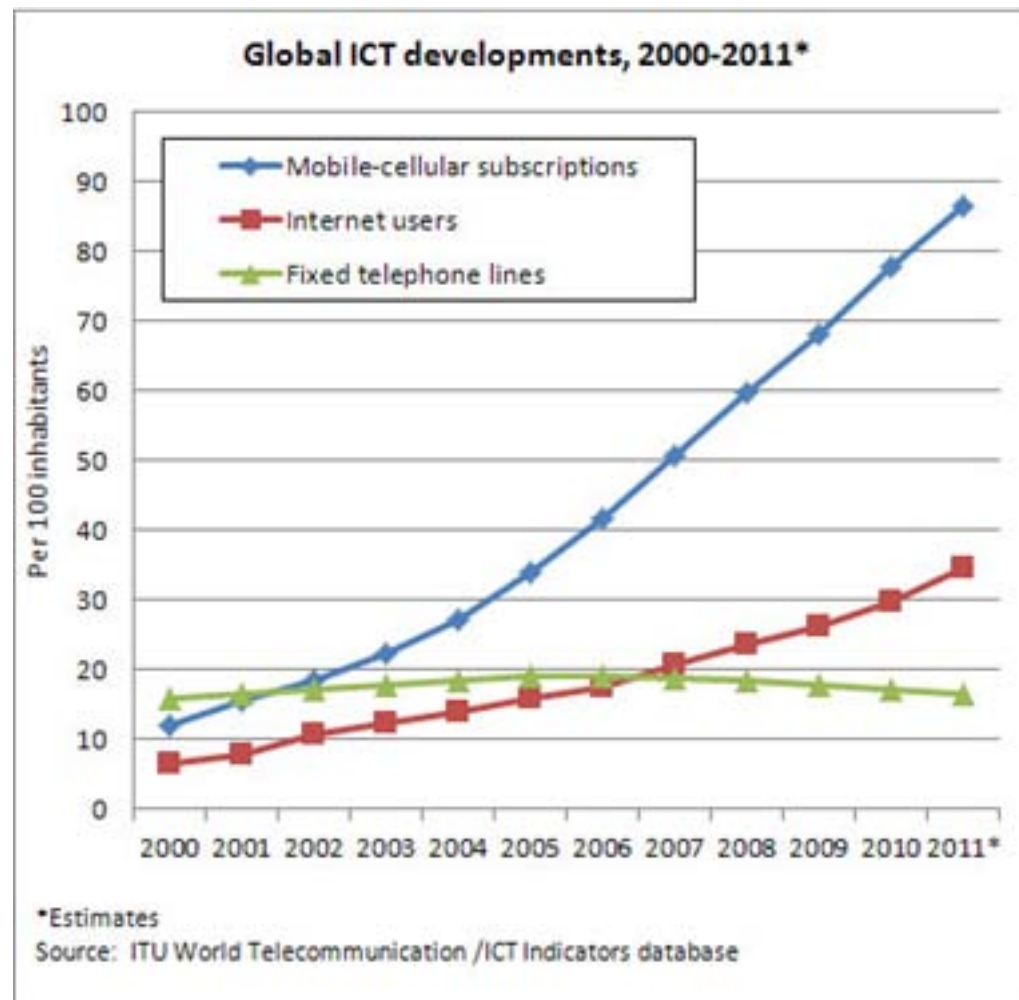
Arguably the most widely used simple technology in health today is the telephone. Nowadays most people carry with them a device called a cell phone or mobile phone – it does what Alexander Graham Bell’s device did<sup>2</sup> – it can be used to call Mr. Watson in the next room as Graham Bell did, or someone halfway round the world. But it also does significantly more. In fact, a smart phone of 2012 packs the computational power of a desktop computer produced in the early 2000s. Whereas in the past we had to take our problem to where the technology was available, mobile devices bring the technology to wherever the need arises. This is a powerful and compelling paradigm shift. With it have come numerous opportunities to support people in their engagement with their health and wellbeing. The number of applications for the iPhone alone now number in the tens of thousands. And the diffusion of cell phones world wide (see fig. 4) is such that it is the technology of choice for reaching the largest number of people. As Archbishop Emeritus Desmond Tutu in his capacity as Chair of the GeHAP puts it,

*“If we want a vehicle for reaching the underserved with interventions from health and other sectors of the economy, the mobile phone is the technology of choice.”* <sup>20</sup>

So, just as eHealth is said to be the future of health, mHealth is the future of eHealth.

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<sup>2</sup> Alexander Graham Bell obtained the first patent for a telephone in 1876, see [http://en.wikipedia.org/wiki/Invention\\_of\\_the\\_telephone#Alexander\\_Graham\\_Bell](http://en.wikipedia.org/wiki/Invention_of_the_telephone#Alexander_Graham_Bell)



*Fig. 4: Diffusion of cell phones, fixed lines and the Internet.*

## *CONCLUSION – THE FUTURE IS HERE*

So, what does the future hold? Take the case of the paperless hospitals: The Indiana heart hospital is a completely paperless institution.<sup>21</sup> Benefits in health workforce time saved. A good example is staff time. how much time health workers in one system typically spend on paper work – as much as one hour for every hour spent on patient care, in Emergency care. Paperless systems also ring the major benefit of eliminating the vulnerability of health care structures to medical errors to which paper records are extremely prone.

In the area of imaging devices, the handheld ultrasound system unveiled by General Electric in 2010 is a harbinger of what the future holds. The GE Vscan measures about 3 inches, wide; 5.3 inches long and 1 inch thick – only slightly larger than a cell phone. Yet it packs the functionality of a 3D ultra-

sound system with color and motion. Some have dubbed it the stethoscope of the 21<sup>st</sup> century.

And the progress of technology and innovation to the benefit of health continues in a wide spectrum of areas. Researchers in Washington University have been able to sequence a baby's genome before it was born. They did so non-invasively by using the genomes of both parents and free-floating fetal DNA, which circulates in the mother's blood. The technology can detect more than 3,000 diseases that are caused by mutations in a single gene.

It would appear that as science-fiction writer, William Gibson, put it, "The future is already here – it's just not very evenly distributed".<sup>23</sup>

As with all technologies, it is clear that various entities (people, institutions, organizations, corporations, associations, etc.) can be the victims of technology, by drifting along with the tide of technology changes. Or, they can be the beneficiaries of the eHealth revolution by properly playing their role in managing the transformation of the health system that is being driven by technology innovations, and charting a course for ICT in health through addressing the eHealth Grand Challenges, with the support of a) an organized eHealth profession; and b) national eHealth policies and strategies.



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