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Tele-Ophthalmology: Using Communication Tools to Empower our Eye Care Services

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Introduction

In many countries there continues to be limited access to healthcare for large segments of the population, cost inflation and uneven geographic distribution of quality medical care. Hence, the availability and access to adequate medical care continues to be a major challenge.[1] Consequently, the use of electronic information and telecommunication technologies to provide or support long-distance clinical healthcare has been rapidly extending.

While not all the medical specialties have fully developed their applications in this new field, ophthalmology stands to benefit substantially from it due to its high volume of diagnostic and follow-up digital imagery.[2-4] Here, telemedicine offers almost endless possibilities of transmitting imagery, whether still or live, depending on the network and communication infrastructure available.

Our First Steps in Telemedicine

The Instituto Zaldivar is an Ophthalmic Ambulatory Surgical Center, located at the foot of the Andes in Mendoza, Argentina. It is primarily specialized in Cataract & Refractive Surgery, and it possesses clinical branches in the cities of Buenos Aires-Argentina and Asunción-Paraguay. It also includes a Laser Network with laser centers located in [4] Argentinean provinces.

In the early nineties, we began our journey into telemedicine by linking our center to similar ones in the United States. The purpose was to share the databases for research and development (R&D) purposes. At the time, a Novell network with data transmission was installed using a 9600 bps MODEM. This implied waiting all night long for the information to get through.

During the ensuing years, we made several attempts to create an electronic medial record database (EMR) and to enlarge the local network by installing LAN-based workstations in each section of the Institute. Having workstations at each section increased the efficiency of the staff in terms of patient workflow by facilitating data input into an organized framework at a higher speed, avoiding the time-consuming chores of writing everything down on paper and carrying the documents from one section to another.

e-Learning: The first e-learning encounter was conducted by means of a hybrid telecommunication model in 1998. It was a live surgical session from the Mendoza, Argentina to Milan, Italy. A closed-circuit TV system was used internally between the operating and conference rooms at the Instituto Zaldivar. The signal was then relayed by micro-wave to the local TV cable company, uploaded to the nation's teleport by optic fiber lines, and transmitted to Italy's teleport by satellite, which in turn sent the signal to RAI. During this event, 7 live-surgical procedures were performed with interactive participation by both the local surgeon and those attending the meeting in Milan.

The advantages of e-learning are rather obvious in terms of access to high-quality training, regardless of geography or time differences. It is a valuable asset in today's modern world. This transmission served as a proof-of-concept that e-learning is feasible,

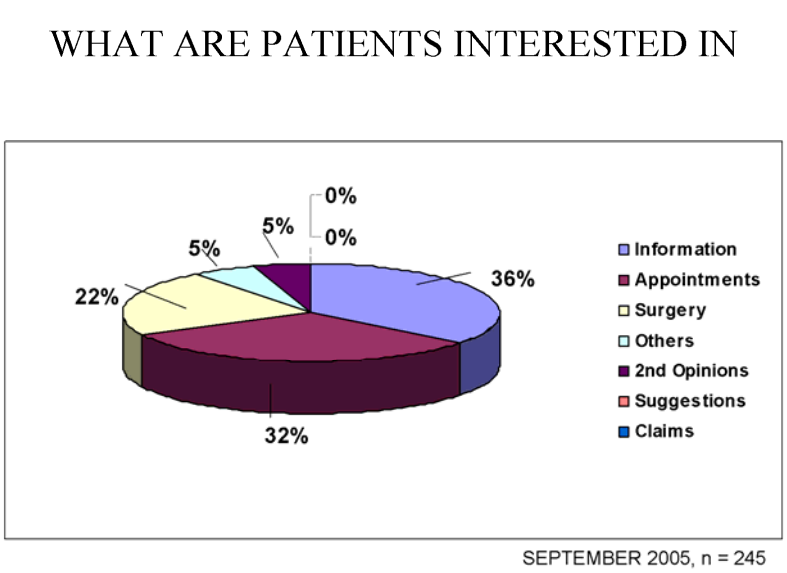

Figure 1.

although the cost of this particular event was high due to the use of satellite communication.

e-Health: During the same time frame, the official website was launched. It was designed to educate the patient population in basic eye care and to provide the latest developments in cataract and refractive surgery, our main specialty. We were able to access high-speed Internet Protocol (IP) connectivity at 128 Kbps. An e-mail-based consultation service was also designed (asynchronous telemedicine model), giving the patients the possibility of booking an appointment online, asking for a second opinion or sending in the results of their eye studies for reading. Specific forms were designed, fast and easy to comply with. Store-and-forward applications were in vogue this period.

In-house analysis revealed that consultations were no longer restricted to patients from Argentina. Indeed, second opinions were solicited from various countries and the inquiries were basically of the same type as those made during a face-to-face consultation: need for clinical information, second opinions, discuss surgery-related issues, financial and administrative questions, etc.(**Figures 1**) Additionally, "digital era patients" came forth with more information and thus expected more from their eye doctors.

In this context, physicians faced a new reality: unlimited access to medical information via telecommunication tools that generated increased patient demand in the time available. Prior to launching the online consultation service, ophthalmic consults -other than regular office visits- were limited. They were made by regular mail, fax or cost-free telephone. The Institutional website enabled online consults and booking service. A total of 6490 online consultations or new consults were performed during the period December 2001-September 2005 (**Figure 2**). Consequently, physicians and surgical counselors experienced physical and legal limitations due to the fact that the patients could not be examined thoroughly and face-to-face. Thus, a liability disclaimer was designed for all outgoing emails containing medical information and through the videoconferencing system.

In the year 2000, a new eye care portal was established, called www.sosvision.com. Its purpose was to link the ophthalmic community, both professionals and patients, by offering custom-made services for each segment. Ophthalmologists could benefit from the project by accessing sensitive information regarding their specialty, being able to buy equipment in an eye care e-marketplace, solicit second opinion from senior colleagues, create and share specific list-servers, have the possibility of publishing information concerning clinical trials or case reports. The idea was to create a network of experts to enhance continuing

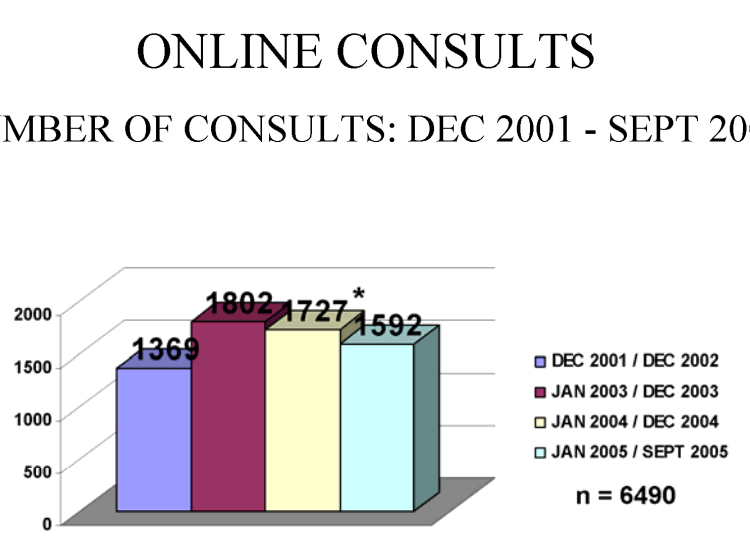

Figure 2.

* ISP Server crashed; new ISP; website under remodeling.

medical education in ophthalmology, as well as, other services for those who lived in remote areas.

Patient education was another primary concern so www.sosvision.com also provided a place where they could find basic information regarding eye diseases (including a multimedia ophthalmic encyclopedia), hints and advice for preventive eye care opportunity to ask for second opinions, and listing of groups to belong to and share their experiences (glaucoma, diabetic retinopathy, subnormal vision, etc.). Financial difficulties in the country limited potential for securing continuous funding. Hence, the project was declared unsustainable and closed one year later.

Ocular Telehealth: In the year 2001, a devastating political and economic crisis occurred, and the country declared its default. The effects on the healthcare arena were devastating. Devaluation and soaring costs impaired the population's access to high quality medical services. In the case of our institute, the majority of non-local patients stopped coming back for postoperative follow-up visits and the number of new consults also declined significantly.

Times of crisis call for creative and innovative action. We designed our first real-time (synchronous telemedicine model) ocular telehealth project. Despite all forecasts, we opened an external clinic in the city of Buenos Aires, setup with a "virtual examination room", where our patients could travel to and have their visits performed through videoconferencing. At the same time, we were able to install an ISDN link between both centers, with a bandwidth of 384 Kbps in both directions. This allowed us to continue offering postoperative follow-up services to patients and encouraged new consultations, as well as second opinion.

During the period December 2001-December 2004, 434 "virtual consults" or videoconference teleconsults were performed between Buenos Aires and Mendoza. The growth of the teleconsults in each speciality has been steady, although cataract and refractive surgery continues to be dominant. During the first year, survey forms were given to those who had a teleconsult. The data revealed that patients expressed the same types of expectations regarding their interaction with the physician in both the traditional (face-to-face) and non-traditional (virtual) consultation modalities.

e-Health Administration: The next step was the development of an online platform that would permit our Institution to administer its healthcare system 24x7. This is an in-house project called FOCUS. The health information system contemplated the use of a workflow-based tool called Netpack® 5 Salud (Symbolic System S. A. Buenos Aires, Argentina) and a virtual private network (VPN) between the branches of the institute. Netpack® was

adapted to our needs, including the redesign of all data-capture forms, the creation of touch screen applications and data-input screens, and staff . This project permits instant online access to all EMR, which in turn enhanced the work of the health management program, as well as, our human resources services and quality assurance programs. Connectivity available at the beginning of the project was 100 mbps internally through the LAN network and 128 Kbps through the VPN- IP-G (MPLS) all the way to Buenos Aires. Currently, this link is being upgraded to 256 Kbps, dedicated exclusively to FOCUS.

Another important step was the acquisition of the new digital telephone system with voice over IP capability, integrated into the VPN IP-G (MPLS) network, with 512 Kbps dedicated exclusively to voice and data. Instant IP communication between the buildings and the other branches, not only resulted cost-effective but enhanced integration of personnel who are geographically disperse.

Discussion

Telecommunications and healthcare in Latin America

The delivery of healthcare using telecommunication in Latin America presents a true challenge. In addition to vast terrains, uneven population distribution, political and economic turmoil, there is the high cost of installation and maintenance of the requisite infrastructure in an often market monopoly. Thus, turn-key solutions may not be practical.

At the same time, there is a global crisis in health care, with the aging populations and the increased demand for high-cost diagnoses and therapeutic resources; the unequal distribution of the healthcare services and personnel in relation to the population; and the increasing costs of delivering care versus insufficient budgets.

The Latin American and Caribbean (LAC) region is no exception, and the most critical problems faced, as expressed by the Pan-American Health Organization (PAHO) in its yearly report are:

- In Third World countries, healthcare problems and costs are important impediments for their social and economic development.
- LAC has a high mortality rate (from diseases that can be avoided) and low life-expectancy.
- Current healthcare models must be re-oriented, responding to the demographic changes and according to the epidemiological profiles, life-styles, urbanization and industrialization of each country.
- There are vast areas and social groups without basic access to healthcare services due to lack of fair access.
- There is a lack of coordination between national institutions and the subsectors and other agents of the healthcare arena.
- In some countries, the financing of the healthcare system is insufficient. This has led to quality and quantitative deficiencies in healthcare services and a widening gap in access basic services.
- LAC has an inefficient distribution of limited resources.[5]

The quality of health care depends on the capture and processing of pertinent information, in a timely manner, for clinical and administrative decision making. Sometimes health-related data are not available or within reach of the providers, decision or policy makers, thereby compromising quality. The challenge is how to integrate communications capabilities into health care delivery.

Given the diverse panorama of Latin America, both technically and politically, the healthcare sector requires a great variety of telecommunication and informatics technology solutions to overcome the limitations of the traditional model of health care delivery. These new tools include high-speed communications to facilitate the provision of universal high-quality and cost-effective medical care.

Universal access to healthcare is not obtained anywhere in the world. Argentina, particularly affected by a long standing political and economic crisis, has suffered during these past years in a profound manner. Not only have costs, salaries, reimbursements, and import restrictions become crucial issues in medical care, but so have healthcare insurance coverage, transportation and communication costs.

The Instituto Zaldivar designed a teleophthalmology program for the benefit of its patients. The program utilizes both the store-and-forward and real-time models. Before launching the online consultation service, ophthalmic consults -other than regular office visits- were limited and made by regular mail, fax or cost-free telephone (call-free line). By

means of the online consult or booking service, the response was overwhelming, with a significant increase in the number of consultations: 6490 new consults were performed during the period December 2001 and September 2005.

Since the implementation of the real-time model in December of 2001, 523 patients have been examined, 67.41% concerned refractive and cataract surgery patients. All patients who originally attended at the Instituto Zaldivar for surgery had their follow-up visits performed at the Buenos Aires spoke site.

Our main concerns:

While taking the trip to the world of telemedicine, some concerns have been encountered as small cobblestones in our path.

1. Efficient Remote Diagnoses: When relying on nontraditional methods or techniques to evaluate or diagnose a medical condition, and in our case based almost entirely on patient imagery, resolution and fidelity must be of the highest order. High-resolution digital equipment (cameras, videos, etc) and high-speed connections (broad-band) have become important allies for those who deal with great volumes of images in their telemedicine practice.[2, 3, 9-13]

2. Standards and Security Issues: Although the new digital era allows for digital imagery and faster communications, enhancing the possibility of remote diagnoses, it also presents new problems including: insufficient bandwidth, noisy transmission, hackers, electrical faults, unknown or equivocal users, etc. Therefore, there is a real need for standards and legislation to guarantee the proper use of medical information as well as adequate transmission, safe processing, storage, and timely delivery.[(2, 3, 14-17)] Currently, the Institute's database was declared compliant with Argentina's new legislation regarding data protection (Personal Data Protection Act #25.326/00), and was registered as such in the National Database Registry.

3. Direct patient/doctor encounter: Overall, the literature reports high rates of patient satisfaction with telemedicine due to improved access and cost reduction of both time and money. Still, many physicians argue that a face-to-a-face assessment simply can not be replaced by a remote consultation. Detractors base their claim on the lack of direct access to the eye and poor image quality for diagnosing or assessing the patient's eye condition properly, as well as the lack of direct physical contact with the patient.[12] Legal and regulatory issues may vary from one country to another, but the ethical issues are the same worldwide. The patient/doctor relationship demands privacy, confidentiality, and security. These parameters are essential and mandatory. Although a teleconsult is performed in a virtual environment, in essence it represents an ordinary consultation. Therefore, measures must be taken in order to establish a satisfactory relationship: a key factor in successful consultations, whether virtual or not.[18-20]

4. Sustainability of current telemedicine programs is a key issue. Healthcare costs are not the only ones soaring. In the Latin-American region, the cost of telecommunications, hardware, software and overheads are also soaring. They constitute one of the most important impairments in planning a sustainable telemedicine program.[21] Lack of federal grants or healthcare insurance reimbursement implies the need for private funding. This would require a fee-for-service model in order to achieve sustainability in the long run. In our case, private funds were used to design and implement the program. Once the patient population was educated and accepted this new consultation modality, their demand for it increased substantially making it possible to offer it as a fee-for-service basis. At present, this service is paid for by patients. Health insurance companies have not yet dealt with reimbursement issues. Hopefully, as the market demand increases, prices will eventually decrease and access to these technologies will be universal, a key success factor in telemedicine.[22]

Conclusions

The evolution of the information technologies has made communications even more powerful, faster and with almost unlimited access. Thus, the new digital era has bestowed upon humanity the possibility of having one's private library in one's home and work place.

Both physicians and patients may now have instant access to medical knowledge and services, thanks to various telemedicine applications. These applications have increased the

reach of medical care, regardless of geographic or time barriers, basically by enhancing access to healthcare.

Nonetheless, this new "information revolution" and its impact on society must be studied and addressed carefully. Standards and legislation must stand behind all technological developments in order to guarantee privacy, confidentiality and security of information.

In our experience, the journey through the world of telemedicine has been both exciting and promising. We have been able to communicate with our patients through innovative and creative applications; but most importantly, we have been able to enhance our outreach: timely serving a larger patient population with new high-quality services regardless of geographic location.

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