The Role of Telemedicine and Information Technology in the Redevelopment of Medical Systems: The Case of Kosova

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ABSTRACT

The medical system of Kosova was largely destroyed in 1999 by the departing Serbian forces, leaving behind Albanian physicians systematically excluded from advanced medical services for a decade and medical facilities severely damaged in the course of departure in a region with an infrastructure fragmented over the years. The medical system of Kosova can be analyzed for the effectiveness of the many efforts following the disruption of medical care in the 1990s. In this paper, the application of telemedicine and information is recounted. The medical system of Kosova was offered the concept of the International Virtual E-Hospital and this model was used to support, supplement, and guide a massive program development that involved essentially every physician and medical personnel in the region. Currently, the Telemedicine Center of Kosova (TCK) is providing information resources for medical education programs within the Kosova's medical system as well as regional and international consultations and collaboration. Furthermore, it is developing the human resources that will lead and implement telemedicine programs in this region and making serious strides in the redevelopment of medical systems using information technology.

INTRODUCTION

KOSOVA IS A REGION formerly a part of Yugoslavia, where ethnic strife in the 1990s led to expulsion of the Albanian majority from posts in universities, including the medical schools. The Serbian minority professional staff maintained a medical system that provided basic emergency medical services, in which the infant mortality rate was 51/1,000, among the highest in Europe in 1989.[1] In addition, patients needing advanced medical or surgical proce-dures were sent to neighboring countries for management of their disease. When war erupted in the 1990s, some 800,000 refugees fled the region to neighboring countries with an internal displacement of 300,000 to 700,000.[2] Population of this region is approximately 2 million, effectively displacing 75% of the population.

When the war ended, medical services in the area were deplorable. The departing Serbian medical personnel left behind very poor—if any—equipment that was often sabotaged and

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inoperable.[3] Albanian physicians had not worked in a hospital setting in over 10 years. Young physicians received training and education in their homes and small clinics, and had no experience in a hospital setting.[1,2]

On June 10, 1999, the United Nations Security Council adopted Resolution 1244 authorizing civilian administration of Kosova in a partnership called the United Nations Interim Administration Mission in Kosova (UNMIK) with three components under its jurisdiction. Civil administration was led by the UN and humanitarian efforts were led by the Office of the United Nations High Commissioner for Refugees (UNHCR). Reconstruction was the responsibility of the European Union with institution building by the Organization for Safety and Cooperation in Europe. Security was provided by NATO. Hundreds of thousands of refugees began returning home to a country devastated in terms of infrastructure and services.[4] Over 350 non-governmental organizations (NGOs) registered to assist in Kosova and the initial assessment of the medical situation was rather grim.[3]

On June 12, 2005, Kosova celebrated 6 years of peace in the Balkans but redevelopment of the medical system remains a work in progress. The role of telemedicine in Kosova seems clear as the agent and catalyst for information, evaluation, coordination, and collaboration. The toll of many decades of neglect, occupation, and war left the medical system of Kosova in disarray but not paralyzed. Redevelopment proceeds around an information core with seamless continuity among medical personnel in the region and across the globe.

KOSOVA'S CLANDESTINE MEDICAL SYSTEM

The eruption and the internationalization of war in Kosova brought to light one exceptional and unprecedented example of disrupted medical care in this volatile region. The government of Serbia had dismissed the entire Albanian medical staff from the University Clinical Center of Kosova (UCCK), and all other regional hospitals, and closed the only medical school, the Medical Faculty of University of Prishtina in Kosova a decade before.

This situation became known to the world only after the war ended. The new generation of medical graduates had not seen a patient in a clinic throughout their entire education. Medical school classes were being held in the basements of Albanian homes. The old professors, surgeons, and other doctors did not practice advanced medicine and/or surgery for more than a decade. This represented an enormous problem for redevelopment of the medical system in Kosova. All of the sudden, the number of priorities to be sorted out were overwhelming and local leadership of Kosova was faced with an enormous void in medical expertise just as the refugees were returning.

ANATOMY OF NEED

There was a lack of fundamental medical standards, policies, and practice management guidelines. The hospitals were extremely crowded, yet underutilized. There were no new diagnostic or treatment modalities for most of the diseases. There was a lack of the most basic medical systems such as epidemiology, preventive medicine, specialized disease management, emergency care, and surgery. The realization of these services, however, still remains a work in progress. A large number of patients were coming back to hospitals with advanced diseases. Internationally contracted physicians organized urgent services to patients who could not be managed in the region and were sent abroad for treatment. A backlog of operating procedures was created and the list of patients awaiting operations continues to grow.

Infectious diseases such as tuberculosis and other medical problems are emerging. There is a great fear that acquired immune deficiency syndrome (AIDS) will soon become a serious problem in Kosova, and drug abuse is significant. Air pollution is extremely high, and there is a lack of public education on health-related issues and health hygiene. Smoking and smoking-related diseases are very serious healthcare problems in Kosova.

It is difficult to prioritize and focus human volunteering energy in such disarray. What should be done first? Certainly, short-term volunteers operating in a Prishtina hospital with

dozens of young surgeons looking on, while very important, could not fulfill the great need of the population. A basic organization was needed and it must be realized while full service delivery is continuing.

Health services are the responsibility of the UNMIK Ministry of Health with a shadow authority of Kosovars that has steadily taken ever greater responsibility. Initially, the staffing of the healthcare system was heavily supplemented by international contract physicians in anticipation that Kosovar physicians would assume full responsibility when training was complete. The medical school was aided by Dartmouth University to reestablish and implement a curriculum. A public health infrastructure was put in place[2] and a strategy for developing medical leadership was formulated.[1] Emergency services for prehospital through rehabilitation were assessed and addressed, although many frustrations were encountered.[3,4]

There was an obvious need for electronic information and distance learning because there was no medical library, information system, or facility for training. The rapid training of Kosovar physicians would not tolerate the absence of physicians for training because there were insufficient personnel to cover in their absence. The six district hospitals have over 5,000 beds among them[1] with Prishtina University Hospital as the lead tertiary center with excess of 3,000 patients per month, requiring about 150 emergency operations per month.[3] The entire medical staff of the hospital of UCCK is 2,179 and carries a considerable work load.

The situation invited electronic and telemedicine solutions with international cooperation. The idea to establish and implement telemedicine in Kosova was presented for the first time at a G-8 Telemedicine meeting in Berlin May 4–5, 2000, by the author, Dr. Rifat Latifi.[5] Over the next year the idea was pursued appropriately by potential partners and sponsors.

MATERIALS AND METHODS

Based upon the assessments done by the authors, medical volunteers in Kosova and the World Health Organization (WHO) findings,[4] the objective was to design and implement the Telemedicine Center of Kosova (TCK) as a sus-

tainable and functional portal for information within and outside the region with a training center for telemedicine. The system would provide state-of-the-art medical education, consultation and transmission of medical clinical data between the UCCK and the regional hospitals in Kosova, as well as between Kosova and the international medical community. Intermediate goals were as follows:

1. Establish advanced and sophisticated communication systems within the UCCK in Prishtina and between UCCK in Prishtina regional hospitals and health house centers in Kosova;
2. Create human capacity to operate the telemedicine program and all its services (technological, educational, electronic library) independently;
3. Using these communication tools by physicians and patients from Kosova to peer hospitals and medical institutions abroad;
4. Provide medical students and Medical Faculty in Prishtina and its dentistry and pharmacy branches with electronic medical textbooks, scientific journals, and other teaching and didactic materials that are equal to that of peers of medical schools throughout Europe and the Western world;
5. Develop and integrate telemedicine principles into the fabric of medial practice in the region;
6. Incorporate telemedicine and medical informatics into the clinical curriculum of the Medical Faculty of University of Prishtina in Kosova;
7. Develop conduct, and support research protocols not only in the telemedicine area, but also in other clinical fields, in order to test and obtain evidence-based medicine;
8. Perform outcome analyses of telemedicine applications in Kosova and develop new tools and means to provide telemedicine and virtual medical education, and finally;
9. Create a Web portal and provide links to the existing Web-based educational programs in one organized step.

The Telemedicine Association of Kosova was founded in Prishtina, September 30, 2000. On

February 2, 2001, a Memorandum of Understanding (MOU) for the implementation of a TCK was signed by all healthcare providers in Kosova. This included the Ministry of Health, the Telemedicine Association of Kosova, the medical battalion of the Kosova Protections Corps (KPC), the UCCK, The Medical School, The Medical Association of Kosova, the Kosova Foundation for Medical Development, the Department of Surgery of Virginia Commonwealth University, and the WHO.

After extensive preparation, with funding from the European Agency for Reconstruction, the Telemedicine Center of Kosova was inaugurated on December 10, 2002, making way for the official beginning of the first phase of development of the TCK. This was a historical moment for Kosova and for the Balkan countries that received extensive media coverage locally and abroad.

DISCUSSION

The TCK is located at the UCCK in Prishtina, and is approximately 1,000 m^2. The center includes a 100-seat electronic auditorium, a computer training room with teaching space for 25, a telemedicine training room, technology support laboratories, a resource room, an electronic library, and administrative offices. The center is equipped with computers, fiber connectivity using integrated services digital network (ISDN), video production equipment, video streaming capability, and computer servers. The TCK operates its own virtual private network (VPN) and a local area network (LAN). Figures 1 and 2 illustrate how this network has been set up.

Telecom of Kosova installed the ISDN lines. This is the highest quality currently available in Kosova. All state-of-the-art equipment has been selected for compatibility, interoperability, and overall effectiveness to ensure sustainability. The electronic library and resource room offers instructional modules with various electronic books and scientific journals through different world-wide programs and other publishing companies and resources.

The Learning Center (Fig. 3) encompasses the latest in image projections systems, interactive capabilities, and diagnostic tools. This center has the capability to effectively encompass, store, and deliver educational content within the UCCK, regional hospitals, and the world. Current systems within the facility allow for acquisition, editing, storage, and streaming of educational modules created by the staff of the TCK and its collaborators. The library has a full range of medical texts online, search capacity, and printers. The faculty and the students of UCCK have direct and unrestricted access to more than 2,100 electronic journals, through the WHO Health InterNetwork Access to Research Initiative (HINARI) program, which provides online access to the major journals in biomedical and related social sciences, the latest medical publications and books (in English). The TCK works closely with publishers to obtain unrestrictive access to publications from companies such as Landes Bioscience (Austin, TX).[6] The Learning Center is open 24 hours a day/365 days a year, and is widely used by physicians, medical students, nurses, and other healthcare professionals.

The Center is managed by a team of Kosovar medical personnel and engineers. It was inaugurated as an integral part of the UCCK and is closely affiliated with the medical school, which is on the same campus as the hospital. Personnel were trained at collaborative laboratories in the United States and collaborators from the United States and Europe have worked in training on site.

As with other institutions from developing countries, international cooperation and collaboration is mandatory for successful development. Since 2002, TCK has collaborated with more than 20 universities and institutions, publishing companies, and others to help enrich its activities and knowledge. This successful international cooperation has been in the form of educational programs, videoconferences and seminars, lectures, consultation and other forms of mutual collaboration with universities in Europe, the United States, and other countries. This activity and partnership is being coordinated into a coherent schedule of year-round teaching curriculum.

Live consultation between international academic sites in the United States and Europe and TCK are conducted using IP protocols or ISDN. The system also supports store-and-forward, when applicable using published international teleconsultation practice guidelines.[7] Regional
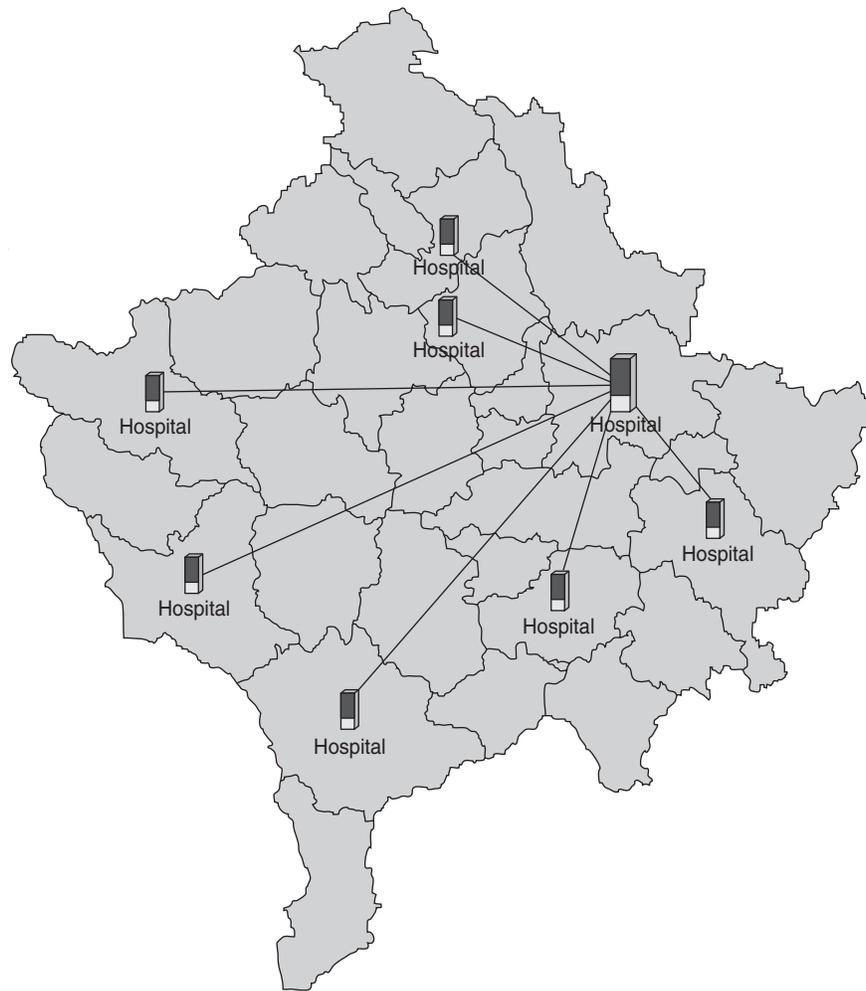
FIG. 1. Virtual private network of telemedicine program of Kosova with its regional hospital telemedicine centers.

hospitals in Kosova will come online in the near future to provide a strong foundation for collaborative efforts. This activity is enriching the expertise and subsequently improving medical care for the people of Kosova, especially in fields lacking in expertise.

RESULTS

Information resources

In October 2002, The First Intensive Balkan Telemedicine Seminar was held in Prishtina with some 400 participants from 21 countries. Proceedings from this international telemedicine meeting were published by IOS Press as a book entitled *Establishing Telemedicine in Developing Countries: From Inception to Implementation.*[8]

During this seminar the newly acquired infrastructure permitted live demonstration from the medical campus of Virginia Commonwealth University in Richmond, including intraoperative distance learning demonstration. On December 10, 2002, the TCK became operational.

The greatest utility of the Center was not foreseen. As the only library for some 1,885 medical students, the Center has provided computer resources for all students and instruction in electronic resource.[9] Formal and informal courses have been conducted with 100% participation of all medical students. More than 54,000 visits by doctors, students, nurses, and other healthcare providers have been registered in the TCK since January 2003. The electronic library has had 9,499 entries, since the start of HINARI program in November 2003 (Table 1). The entire electronic library has also
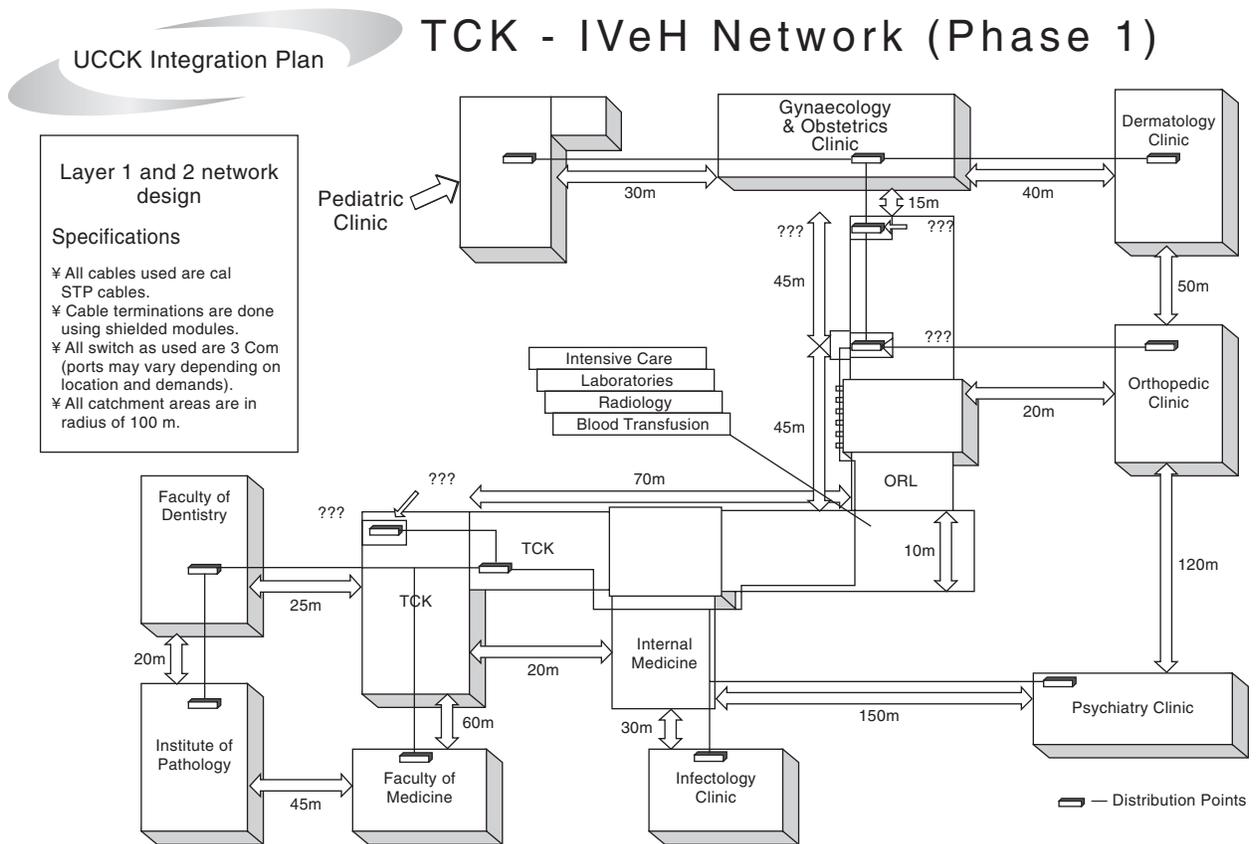
TCK - IVeH Network (Phase 1)

FIG. 2. Graphical presentation of local network at UCCK.

been made available in the regional hospital in Peja, the western most city of Kosova, where hospital personnel are undergoing training in electronic library use, computer use, and the English language (Fig. 1). As part of Prishtina Summer University (2004) 36 medical, dental, pharmacy, engineering, and business students of University of Prishtina successfully finished a 3-week intensive telemedicine course, Telemedicine and Telehealth in Modern Medical Care. This course offered state-of-the-art telehealth education and hands-on knowledge of the equipment used in telemedicine. These graduated students represent a powerful cadre of individuals who can support and advance telemedicine in Kosova, ensuring sustainability of the telemedicine program.

Continuing education

The TCK has been utilized for 43 regional and international conferences in continuing medical education including live Web broadcasting of surgical procedures as of March 2005. The facil-

ity is well suited to connect to primary sites in Europe or the United States for classroom participation in Kosova. The sessions cover the spectrum of medicine and have largely served the staff of the UCCK. The leadership of UCCK continues to offer encouragement to the Center by serving as the heart of medical education for the university clinical center staff. The electronic library of the Center is also the main information resource of the hospital. The Center personnel have provided advice and leadership to connect different departments of the UCCK with telecommunications lines. This VPN, extended to the operating suites throughout the UCCK, is providing abilities for live broadcasting of general surgery procedures, endoscopic procedures as well as dental procedures and is offering telesurgical training and mentoring to a wider audience of local surgeons (Fig. 3). Live and interactive teleconferences from the operating rooms are transmitted to a larger audience in one or more classrooms, instead of large groups of students crowding into operating rooms. This also adds significantly to the expo-

FIG. 3. Learning and Resource Center at the Telemedicine Center of Kosova. The center is open 24 hours a day.

sure of medical students to clinical education. This approach will be used for other clinical disciplines, such as radiology, dermatology, infectious disease, cardiology, pathology, psychiatry, pediatrics, and others.

Clinical practice

The establishment of telemedicine protocols, consultation policies, second opinions and development of other modes of collaboration within the Center, and between the UCCK and other regional medical centers in Kosova in the fields of dermatology, pathology, family practice, ear, nose and throat, ophthalmology, surgery, internal medicine, cardiology, and dentistry have been accomplished. A database of all clinical activities has been created and consultations within the region and to collaborators abroad have been accomplished.

Programs in evolution

A 1-year fellowship on telemedicine and e-health is being developed at the TCK in collaboration with well established telemedicine programs in the United States. This program will help ensure continuation of telemedicine in Kosova. There are other sites in Kosova where telemedicine facilities are anticipated for regional consultation and education. The first two of those stations are now installed (Sken-

deraj and Prizren) and were scheduled to begin operation in the fall of 2005. Training of personnel for regional hospitals is being performed at the TCK as illustrated in Figure 4. The Center is serving as the hub for a seamless telemedicine program integrating the responsibilities of medicine overall in Kosova where

TABLE 1. "VISITORS" TO ELECTRONIC LIBRARY OF THE TELEMEDICINE CENTER OF KOSOVA[a]

Year	Months	Med. Staff	Students	Others	Total
2003	November	198	340	5	543
	December	211	416	3	630
2004	January	231	256	3	490
	February	190	212	1	403
	March	295	254	7	556
	April	263	354	5	622
	May	279	440	2	721
	June	262	372	6	640
	July	118	148	5	271
	August	72	73	7	152
	September	143	156	11	310
	October	143	174	2	319
	November	145	288	10	443
	December	150	367	10	527
2005	January	140	268	2	410
	February	210	254	3	467
	March	262	288	3	553
	April	199	240	6	445
	May	221	261	3	485
	June	216	294	2	512
	Total	3948	5455	96	9499

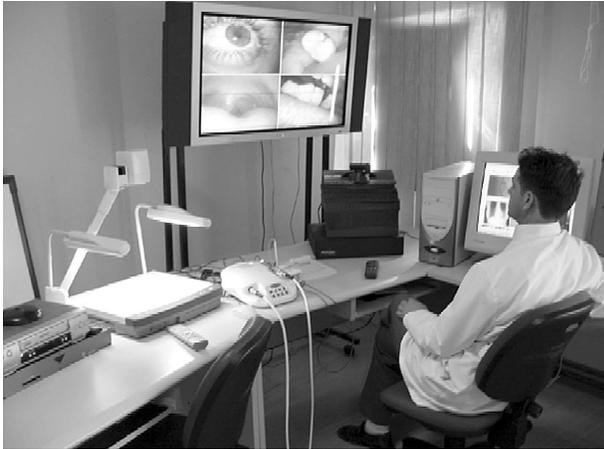[a]Since the implementation of the HINARI Program.

FIG. 4. State-of-the-art telemedicine training room at TCK.

patients in the distant clinics often require consultation or longitudinal disease management by the UCCK. It is expected that telemedicine services will greatly improve overall medical services in Kosova and prevent needless, expensive patient transportation to UCCK. For example, the town of Skenderaj, 60 km from Prishtina, and one of the most underdeveloped areas in Kosova, had 2,100 emergency transfers to the UCCK in 2004. Of these 1,800 were sent back to the referring facility, with transportation costs of $50,000.

Clearly, the use of telemedicine to communicate clinical needs and coordinate care better will be a significant adjunct to healthcare in the region. The second phase of the project will integrate the nine regional telemedicine centers in Kosova in Gjilan, Ferizaj, Prizren, Gjakovë, Pejë, Mitrovicë, Skenderaj, and two in Prishtina (Fig. 1). The health system of Kosova will be fully integrated by information, an instructional and consultative system, and supported by a dedicated network of telecommunications. This will include total access to telemedicine systems in Kosova from every hospital, health house centers and private medical practice in the country. These will be supported by IP, ISDN, or by wireless technology.

These nine centers in Kosova will make arrangement for, and ensure the regional health house centers and medical practices will be included in the telemedicine network during the third phase of the project. Their local and regional programs will ensure that proper education is provided for those centers and in-

dividuals and make certain proper leadership is in place in preparation for the implementation of the third phase.

Financial structure

The TCK has been supported by a $1.5 million grant from the European Union through European Agency for Reconstruction. Physical space was provided by the UCCK. Telecommunications connectivity was provided by Telecom of Kosova. Healthcare service is Kosova is provided by 11,500 health workers. They support an estimated population of approximately 2 million. This is 1 worker for every 174 individuals.[11,12] The total 2004 budget for this region was 1.69 billion Euros, or approximately $2.0 billion (USD). This budget was supported by 70% from local revenues, of which 72% was spent on the central government. The allocation for health care was 150 million Euro or approximately $180 million (USD). This equates to $90 USD per capita.[12] The $1.5 million grant for the TCK has an operational budget of approximately $100,000 per year.

CONCLUSIONS

Redevelopment of a medical system in the aftermath of a war-ravaged country presents special and unique challenges. Generally, the population has rather high expectations for services that were so recently theirs. The situation in prewar Kosova was not one of lavish services but there were abundant medical personnel and easy access to the facilities. In emerging countries there is low expectation because there is no established history of medical services at a high level. In these circumstances, medical personnel are carefully trained and services are introduced as resources allow, beginning with the most basic services of hygiene, nutrition, and immunization, with introduction of tertiary services later. In cases of disaster, the public may have been accustomed to a high level of service but sudden events such as a storm or civil disturbance temporarily disrupt service. The population realizes the situation is temporary and attention is placed upon prevention of epidemic, care of casualties and rapid reinstitution of the situation that prevailed before the disaster. Redevelopment in-

volves rebuilding the infrastructure and human capacity after some collapse such as war. The public knows the situation may be temporary but it is not going to be brief. The critical medical personnel may no longer be there and must be provided by training over time.

Unlike restoration of services that can include restoring power and water, redevelopment entails building the power plants, running the power lines and laying the pipes for water. In Kosova, the sudden loss of the medical community and medical facilities became evident at the time when hundreds of thousands of refugees were returning. The population had to be cared for in temporary constructs at the same time infrastructure was being built. In these circumstances there is every reason to be creative. There is no reason to follow the evolution of other medical systems to build toward some generic goal. Instead, many of the steps in the evolution of the model system may be eliminated and the renewal system may leap into an advanced stage of development using technology. Certainly, Kosova has had no problem embracing information technology and telemedicine as a reasonable tool as medical authorities rethink priorities, exigencies and seek the most expeditious ways to reestablish medical care.[8]

Telemedicine may be regarded as a disruptive technology in well developed and functional medical systems in which change is away from something that is already working. However, when the disruption is war, telemedicine can be an expedient to the actual goal of independent medical care in a region seeking peace and independence. On October 23, 2004, elections in Kosova affirmed the rapidly emerging autonomy of the region. Many of the NGOs have gone home. Many of the troops are out of the Balkans, and Kosova is rapidly moving to a position of self-sufficiency. Medicine is part of that self-sufficiency and telemedicine is integral to the new medicine of Kosova.

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