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A Telemedicine Health Care Delivery System

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The ITS system was specifically developed to address the ever widening gap between our medical care expertise and our medical care delivery system. The frustrating reality is that as our knowledge of how to diagnose and treat medical conditions has continued to advance, the system to deliver that care has remained in an embryonic stage. This has resulted in millions of people being denied their most basic health care needs.

Telemedicine utilizes an *interactive* video system integrated with biomedical telemetry that allows a physician at a base station specialty medical complex or teaching hospital to examine and treat a patient at multiple satellite locations, such as rural hospitals, ambulatory health centers, correctional institutions, facilities caring for the elderly, community hospital emergency departments, or international health facilities. Based on the interactive nature of the system design, the consulting physician at the base station can do a complete history and physical examination, as if the patient at the satellite site was sitting in the physician's office.

Integrated into the video system, and based on the requirements of the remote medical facility, are a number of diagnostic devices. The remotely controlled examination camera has a powerful zoom-focus capability that allows a *dermatologist* to examine any aspect of a patient's skin to the smallest detail. An electronic stethoscope, in conjunction with real time digital transmission of an EKG and echocardiogram, permits a *cardiologist* to do a complete cardiological examination. Specific camera adaptors and resolution capabilities enhanced by remote controlled optics provide the *ophthalmologist* at the "base station" medical facility a clear view of the retina of a patient at the referring site. An *ENT* specialist can observe a laryngoscopic examination; a *gastroenterologist* can direct an endoscopic procedure, and a *radiologist* can interpret any type of X-ray examination, including MRI, CAT scan, or ultrasound. A pathologist, utilizing the telemicroscopic adaptor, can examine a frozen section or bone marrow slide, and a *surgeon* or *gynecologist* can participate in a laparoscopic procedure.

A *thoracic surgeon* can instruct a surgeon in a small community hospital to do thoracoscopic surgery, a *urologist* can view a cystoscopic procedure, and an *orthopedist* can direct arthroscopic surgery. To ensure the widespread availability of state-of-the-art trauma care, a

trauma surgeon will be able to examine a trauma victim at a remote location and instruct local emergency physicians as to necessary surgical procedures and resuscitative measures.

A computer-controlled switching matrix allows for networking of the central base station to multiple remote locations; if desired, a video recorder can provide retention of consultations for record keeping, quality assessment and teaching purposes. A high speed, plain paper facsimile affords immediate and efficient document transfer (patient records, prescriptions, consultation notes, references from a PC-based data base, etc.). Freeze frame capability allows any image projected at either the base station or peripheral site to be "frozen" and sent as a slide to the other site. With a special "menu" provided by the control panel, X-rays, EKGs, or slides can be annotated with an electronic pen. An X-ray can be viewed on one video monitor while the patient examination is occurring on a second monitor.

This interactive telemedical system has introduced a unique *continuing medical education* experience for the primary health care provider. Since the specialist at the hospital base station can evaluate the patient at the same time that the primary care physician does, the primary care physician is provided an immediate interactive educational input that he would not have if he referred the patient to that specialist outside the satellite facility. As a result of this simultaneous interactive consultation between primary care physician and specialist, the educational level of that primary care physician is improved, resulting in the ability to handle more complex problems and effect more appropriate specialty utilization. By providing the comprehensive physician expertise available at a major medical center, the ITS system ensures that the latest advances in diagnosis and treatment are made available to the patient. Additionally, since the patient does not need to be transported to the specialist, he can be treated sooner and at a less serious stage of the disease process. Specialty availability plus immediate access means improved *quality care.*

The ITS system, by reducing the need to transfer a patient to a distant medical facility, maintains *continuity of care* between the patient and the primary care physician. In addition, if a patient does need to be transferred, the primary care physician can be updated on a daily basis by the treating physician at the base station referral site over the telemedicine link. Once the patient is discharged from the referral medical facility, the specialist's ambulatory follow-up care of the patient is also facilitated utilizing the ITS system without the inconvenience of distant travel by the patient.

The cost of a consult over the interactive system is equivalent to the cost of an EKG or chest X-ray! Additionally, by decreasing the need to transfer patients, for example from a rural hospital to the urban center for consultation, there are cost reductions as a result of the differential costs between the two facilities as well as avoiding transportation expenses and requiring less time away from work. But as overall health care costs are reduced, the revenue generated at the satellite and base station facilities is enhanced. By decreasing the need to send patients to other locations

for care, they stay in the rural hospital bed where both the hospital and primary care physician can bill for the additional patient stay. Although total referrals from satellite facilities requiring transport to a medical center are reduced, referrals that do occur tend to be sent to the base station facility, a result of the networking that has been established.

The base station space requirements are equivalent to the square footage of a physician's office. The satellite site requires space equal to a physician's examination room. The system is compatible with multiple types of communication systems (telephone line, cable, microwave, and satellite). Both the base station and satellite site equipment is easy to install, and can be easily relocated, if the original site location needs to be changed. The system is also adaptable to a mobile configuration in that the equipment can be placed in a small van and taken to multiple satellite sites. This flexibility allows a satellite site to have access to the specialty medical center on an "as needed basis" and the distance capacity of the system allows a cardiologist in Boston to examine the heart of a patient in Alaska, Maine, or "around the corner."

The ITS telemedical system thus provides *immediate access* to quality health care. It *resolves* the problems inherent in our existing system of: 1) geographic or socioeconomic isolation for the patient; 2) professional isolation for the physician; 3) escalating costs; 4) inappropriate utilization; 5) loss of continuity; and 6) ineffective CME.

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