An ISDN-Based Telemedicine System

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THE IDEA OF DIGITAL Radiology has been around for some time. However, there were fewer research initiatives occurring in Taiwan. Prior to 1995, there were only a few small-scale experimental PACS systems developed and operating.¹ The circumstances have changed since 1995. With the launch of the National Information Infrastructure (NII) Initiative, the Department of Health (DOH) started funding several Telemedicine projects. This action got more vendors involved in medical imaging system development. The preliminary results also attracted the attention of hospital executives. On June, 1995, Computer & Communication Lab. (CCL) installed its PC-based telemedicine system at the Tri-Service General Hospital (TSGH), linking the Radiology and Neurology Departments that located at separate campus.² The next year, TSGH also received a 3-year grant from DOH. The mission was to establish a telemedicine link between TSGH and the Lian-Jian County Hospital (LJCH). Lian-Jian County consists of several islands located 140 miles northwest of Taiwan. The population is around 4000. The 20-bed county hospital has 5 physicians, all in family practice and with no residence training. The major goals of this project are to (1) provide better healthcare to the Lian-Jian county residents, (2) reduce the number of unnecessary patient transfers from Lian-Jian County to Taiwan, and (3) provide on-the-job training of County hospital physicians. The TSGH-LJCH Telemedicine has been in operation since May, 1997. 124 cases were teleconsulted between May and October, 1997. This article provides operational data and preliminary survey results during this time period.

THE TELEMEDICINE SYSTEM

The Telemedicine System (see Fig 1) consists of two teleconsultation stations (one located at TSGH, the other at LJCH), and a multimedia electronic medical record system (at TSGH, for storing the multimedia medical records of the patients participated in teleconsultation). Each teleconsultation station is equipped with a video conference system (a CODEC and a 32" TV) and a high resolution teleradiology workstation (for displaying multimedia electronic medical record, includes X-ray and CT images). The CODEC at LJCH also connects to

a SONO. X-ray and CT images are captured via a film digitizer. Document cameras are used for on-line hard-copy documents capture when necessary. The two teleconsultation stations are linked by 6 BRIs ISDN (with total 768Kbps bandwidth) for images and real-time audio/video transfer.

In most cases, the teleconsultations were set up by appointment, with patients' data transferred in advance. In emergency (2 out of 124), it can also be set up through immediate request, with patients' data sent on real-time basis. Sometimes, patients were not present as the consultations took place (8 out of the 124). In those cases, it was simply a case study between the physicians at both sides of the Telemedicine System.

RESULTS AND DISCUSSION

Teleconsultation by Category

Figure 2 shows the teleconsultation cases distribution by category. The top 7 requests amount to 75% of total cases. Although Orthopedic seems to be the most popular teleconsultation category, our data shows that its requests decreased quite sharply after the third month. Since most of the referral physicians agree that consultations do help (this issue will be addressed later), it is reasonable to assume that the sharp decrease in requests was due to improvement in the confidence levels and diagnostic skills of the physicians at LJCH side.

Impacts of Teleconsultation

We did some assessment to determine whether the Telemedicine System achieves the goals set for it. A questionnaire given to the referral physicians after every case indicates that they agree (1)

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Fig 1. The TSGH-LJCH Telemedicine System.

specialties at TSGH are either very helpful or helpful to their diagnoses in 92% of cases, and (2) the teleconsultation process indeed improved their diagnostic skills in 69% of cases. Other preliminary outcomes also show that the Telemedicine System reduced unnecessary transfers and improved quality of healthcare by avoiding misdiagnosis. For example, 39 suggested transfers (out of 51) were later considered unnecessary by specialties at TSGH during the teleconsultation process. On the other hand, 9 cases (out of 48) were identified to be more serious than the referral physicians originally thought, and were transferred after the teleconsultation. The number of disagreed diagnoses appears to be rather high in the early months. We expect that it will decrease over time as the referral physicians improve their skills.

Fig 2. Number of teleconsultation requests by category: (1) Orthopedic; (2) Dermatology; (3) Otolaryngology; (4) Ophthalmology; (5) Neurology; (6) Urology; (7) Psychology; (8) Other 13.

Reimbursement Issues

The average cost of a teleconsultation case is about \$83 US (\$63 for video/data communication and \$20 dollars for physicians), which is currently covered by the experimental project. The physicians at both sides receive about \$10 for each review—the same as emergency consultation fee regulated by the National Health Insurance Plan. However, our survey showed that 43% of the physicians at TSGH and 61% of physicians at LJCH think that the reimbursement should be \$30 or higher. Yet, only 39% of patients would pay for more than \$15 (by National Health Insurance Program, a patient only needs to pay \$4-\$8 registration fee for an outpatient visit). It is expected that the reimbursement policy would be a major issue if Telemedicine were to be included in the National Health Insurance Program in the future.

Quality Issues

Communication. Quality of communication has been the most disturbing issue from the very beginning. One out of 10 cases experienced video/audio communication interruptions during the teleconsultation session. The ISDN line has been the

Table 1. How Well Do You Communicate With the Far Side Doctor?

	Very Good	Good	OK	Poor	Very Poor
TSGH-doctor	6%	63%	25%	6%	—
LJCH-doctor	15%	70%	15%	—	—
LJCH-patient	23%	62%	15%	—	—

Table 2. Do You Think the Teleconsultation Service Should be Carried on After the Experiment?

	Yes	No comment	No
TSGH-doctor	81%	19%	—
LJCH-doctor	100%	—	—
LJCH-Patient	85%	—	15%

major culprit. However, many doctors do not seem to have problem with this. In fact, some doctors are quite comfortable with the combination of phone and fax machine when video is not available.

Image. All doctors considered the digitized X-ray/CT images good or even very good.

Video. Although the acceptance rate of video is 87%. It is far from diagnosis quality. Specialties like Dermatology, Otolaryngology, and Ophthalmology require to see patients closely usually found the video quality quite unacceptable.

Other survey results of interest are outlined in

Tables 1 and 2. It is not surprising that physicians at LJCH are more positive about the Telemedicine System. However, 15% of patients consider the system "of no value." When we examined the situation further, we discovered that those 15% think that they did not communicate well with the far-side doctor, either. Perhaps those patients are just uncomfortable with the doctor on TV.

SUMMARY

Our preliminary results show the telemedicine system is successful. It does fulfill the 3 goals we set earlier. However, for such a system to be cost effective, the communication cost need to be cut further. In fact, video is not required at all time. We are hoping to establish criteria and operational procedure for use of video. Also some sort of standard should be set up for evaluation of the quality of telemedicine.

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