

A Telemedicine System As a Care Modality for Dementia Patients in Korea

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Summary: Because dementia is a chronic debilitating disease, there are the issues of the difficulty in continuous long-term care and limited accessibility to medical service. We developed the telemedicine system for dementia patients and aimed to examine the acceptance, reliability, and clinical outcome of our telemedicine service. We established the Dementia Telemedicine Center in connection with two recipient sites in 1996. The reliability of the center, which provides telemedicine, tele-education, and telecounseling services, was tested by comparing assessment via our system with in-person assessment, and the clinical outcome was assessed by rating the changes of behavioral symptoms. There have been 140 registered patients for 2 years. The general acceptance of our system by the patients and caregivers was good, and the consistency rates between the assessment via our telemedicine system and in-person assessment ranged from 76% to 89%. A considerable proportion of dementia patients in nursing homes (46%) showed relative clinical improvements through our service. Our telemedicine system seems to be reliable and effective for the assessment and care of dementia patients. Our future direction is to promote our system as a core model of the home-based care system for dementia patients. **Key Words:** Care system—Clinical outcome—Dementia—Reliability—Telemedicine.

The number of dementia patients has grown rapidly because of increasing aged population and extended human life span, and dementia has become one of the most important social and medical issues throughout the world. According to the recently reported prevalence rate of dementia in Korea (Woo et al., 1998), there are currently more than 200,000 dementia patients in Korea. Because dementia is a chronic debilitating disease, the caregiving burden of family members is enormous. This could result in the abuse of dementia patients in cases in which there is no proper support system for family care-

givers. Therefore, the quality of life of dementia patients and their families could be badly affected at any time during the clinical course of disease. Another distinct feature of caring for dementia patients is difficulty transporting them to medical facilities. In addition, the uneven distribution of specialists has caused a limitation of accessibility to medical services for dementia patients in our country. Particularly, underuse of mental health services by elderly persons, including the demented elderly, living in the community has remained a problem (Colenda and van Dooren, 1993). In general, some tenacious problems in the health care system of highly developed or lesser developed countries have been revealed as the uneven distribution of health care resources, inadequate access to health care, and unabating increase in the cost of care (Bashshur, 1997). Telemedicine has been proposed for the purpose of expanding the productive

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capability and extending the distributive efficiency of the health care system through innovative information technologies (Kavanagh and Yellowlees, 1995). We have also considered these aspects in developing our telemedicine system.

Considering the aforementioned medical and social issues related to dementia, we developed a model of the telemedicine system for dementia patients who reside in care facilities as well as for those living in the community. The primary purpose of this model is to provide the efficient care for dementia patients in the care facility where specialists are not present. Another purpose is to increase access to specialists for the demented elderly living in the community. Our further expectation is to improve the quality of life of dementia patients by improving the quality of care and diminishing the family caregiver's burden. Through our telemedicine service, the care system is finally able to create an efficient care delivery network for dementia patients by applying communication technology. Particularly, we aimed to examine the probability of our telemedicine system as a core model of a home- and community-based care system for the demented elderly.

Although telepsychiatry, the application of telemedicine to psychiatry, started in 1956, the first telepsychiatry system to assess patients was reported in 1976. According to a rapid growth of communication technology in 1990s, there has been recent progress in telepsychiatry. Previous studies have shown the reliability of an interactive video interview compared with an in-person interview for a few specific psychiatric disorders (Baer et al., 1995; McLaren et al., 1996; Zarate et al., 1997). Recently, the reliability of cognitive function tests and outcomes of cognitive behavior therapy via the telemedicine system have also been studied (Ball and Puffett, 1998; Manchanda and McLaren, 1998). However, the cost-effectiveness of the telepsychiatry services has not been systematically investigated. It is essential to examine this aspect when proposing a certain telemedicine system that is to be generalized as a novel care modality (Parednia and Allen, 1995; Yellowlees and Kennedy, 1997). This study was not conducted to evaluate cost-effectiveness closely for our system. However, we aimed to examine the acceptance and reliability of our telemedicine service and its clinical outcome to illustrate its specific significance and utility through our experience.

METHODS

Components of the System

The Dementia Telemedicine Center (DTC) was established at Seoul National University Hospital (SNUH), a

host hospital providing the telemedicine service to dementia patients, in Seoul, Korea, in September 1996. There have been five psychiatrists at the DTC who have worked in connection with the Dementia Clinic in the Department of Neuropsychiatry at SNUH.

As shown in Fig. 1, there are two recipient sites of this system: Youngrak Nursing Home and Bukbu Elderly Welfare Center. Youngrak Nursing Home is located in Incheon City, 35 km away from SNUH. It is a special-care facility for elderly patients with dementia who are homeless or have no available caregivers because of low economic condition. There are approximately 160 residing dementia patients and no specialist for their care. Bukbu Elderly Welfare Center is located in Nowon-ku on the north side of Seoul City. There are 30,000 elderly persons older than 65 years in Nowon-ku. At its day care center, approximately 20 registered dementia patients are cared for daily. Each recipient site included a Telemedicine Service Unit (TSU) that employed one nurse. The TSU at the nursing home was mainly provided for dementia patients with behavioral disturbances requiring clinical interventions. In the elderly welfare center, all day care dementia patients received TSU services, as did the elderly living in the community when they wanted. This TSU for outpatients was called "TSU(OPD)."

The Dementia Registry and Information Center, which is connected with the DTC via 64-kilobyte dedicated line, is affiliated with the Korean Association for Dementia. There has been a database server called "Silver Web" for the information service for dementia since 1998. The information service via Silver Web was mainly for professionals caring for dementia patients as well as family caregivers. It also provides support for family caregivers of dementia patients by public communication modes (Smyth and Harris, 1993).

Configuration of the System

This system was established by government fund, and the total equipment cost was approximately \$600,000. The hardware and software configurations were as follows.

Hardware Configuration

Figure 1 shows the hardware configuration of our system, which consists of a videoconferencing and clinical information system. For the clinical information system, there is an Indigo2 server (Silicon Graphics, CA) at the DTC for database management. At each site, there is an x-ray film scanner with 75 dpi and an A4 scanner for the transmission of neuroimaging films and ordering charts, respectively. The telecommunication line is T1, with the

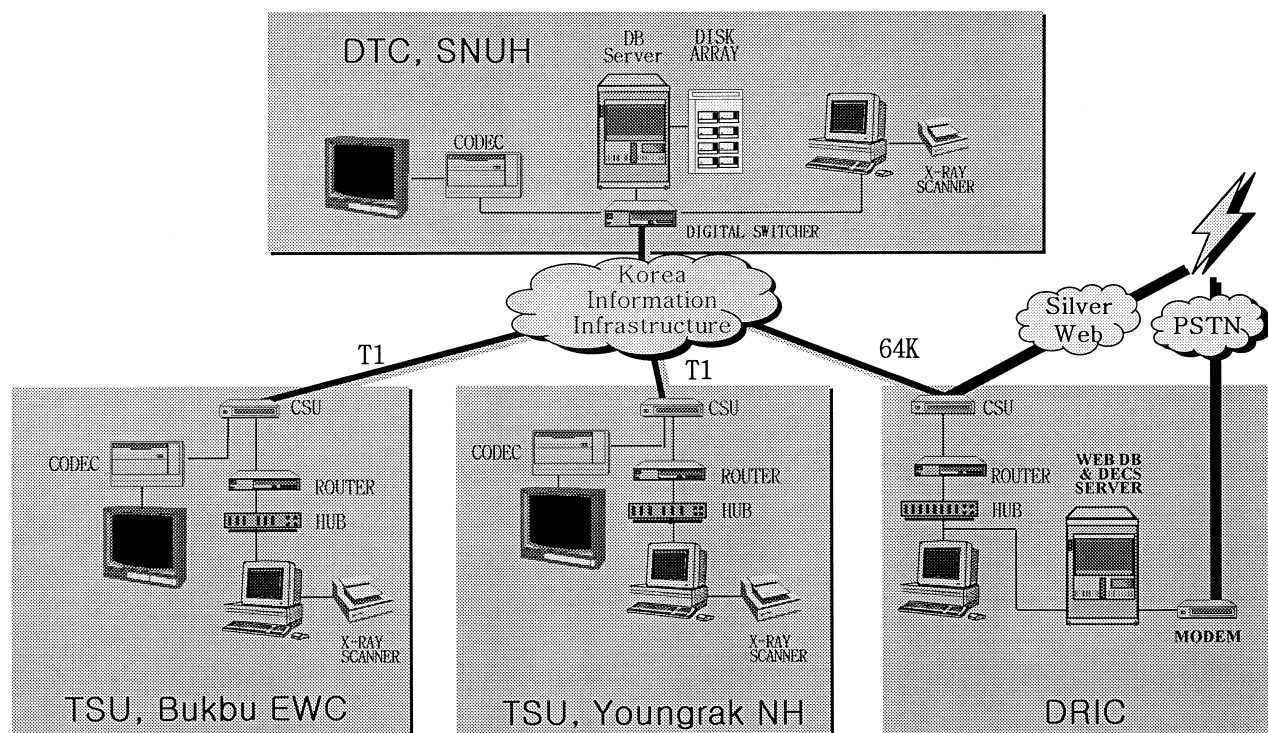


FIG. 1. The hardware configuration of the telemedicine system for dementia patients. DTC, Dementia Telemedicine Center; SNUH, Seoul National University Hospital; DRIC, Dementia Registry and Information Center; TSU, Telemedicine service unit; EWC, Elderly welfare center; NH, nursing home.

transmission rate of 1.544 megabytes per second, through which the data security is maintained.

Software Configuration

The database is composed of three modules: the registry, follow-up protocol, and daily behavior checklist for dementia patients. The database structure of the registry is shown in Fig. 2. Most items in the registry database were included for the diagnostic assessment of dementia, except caregiver data, service needs, and environmental security, which are the items used for caring for dementia patients. Particularly, the cognitive function tests—Blessed Dementia Scale (BDS), Short Blessed Test (SBT), the Korean version of Mini-Mental State Examination (Park and Kwon, 1990), and Clinical Dementia Rating (CDR) scale—are to be used for the research as well as diagnostic assessment.

Flow of the Services via the Telemedicine System

The general flow of our telemedicine service is as follows. The nurse at the recipient site collects the clinical data of dementia patients for the registry. The dementia specialist at the DTC makes diagnoses by reviewing the electronic data of the registry, neuroimaging data,

and laboratory data, and by video interview with the patients. The treatment and care are provided through the video interview and/or the prescription of drugs for the patients at the recipient site. During the videoconference between the doctor at the DTC and the nurse at the recipient site, the detailed supervision on the accuracy of the nurse's assessment and proper nursing care for each patient is also provided. In addition to this telemedicine service, a tele-education service (a series of lectures) to the professional and family caregivers was included. In particular, the telecounseling service for family caregivers was given in either an individual or group setting. Our services to the TSU(OPD) at the elderly welfare center included telecounseling for family caregivers in addition to the diagnostic assessment of dementia patients and care for those who had been referred to the Dementia Clinic at SNUH for further diagnostic work-up.

Acceptance by Users and Consistency in Clinical Assessment

The acceptance of our services via the telemedicine system by patients, family caregivers, and nurses was observed by the specialists at the DTC. The acceptance of the tele-education service was examined by asking

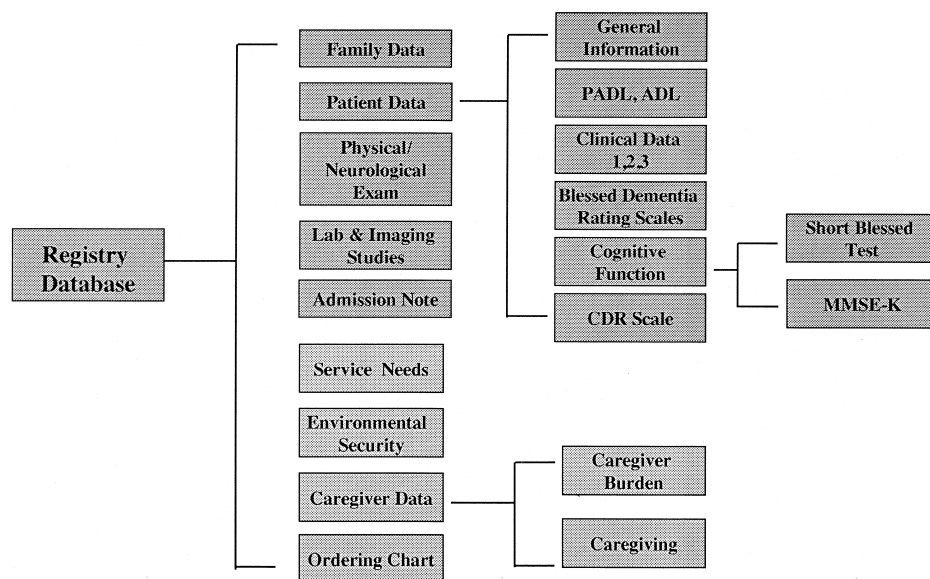


FIG. 2. The configuration of the registry database. ADL, activity of daily living; PADL, physical activity of daily living; MMSE-K, Korean version of Mini-Mental State Examination; CDR Scale, Clinical Dementia Rating Scale.

specific questions about its effect and by comparison with the ordinary education to the family caregivers and professional caregivers. Family caregivers of dementia patients at the day care center included 17 women and 5 men, and their relationship with the patient was daughter-in-law, daughter/son, or spouse.

To test the consistency between the results by two different assessment methods, we compared the scores of the SBT, BDS, and CDR scale and the diagnoses made via the telemedicine system with those made by in-person assessment, which was conducted by the specialists at the recipient sites. The maximum duration between two assessments was less than 3 months.

Clinical Outcome

In the nursing home, the clinical change of dementia patients was assessed by comparing baseline data of the 7-day daily behavior checklist, which was completed by caregivers, with the data after 6-month follow-up evaluation. The daily behavior checklist is a 41-item questionnaire for monitoring the patient’s problematic behaviors and sleep disturbances (Woo et al., 1995).

The caregiver’s burden was assessed by administering the Zarit Burden Interview (Zarit et al., 1986) to family caregivers of dementia patients at the day care center and comparing data at baseline with those after 6 months.

RESULTS

The results of the services via our telemedicine system from January 1997, until December 1998, are summarized as follows. During this period, the total number of

registered patients was 140 (Table 1), and the total number of system users, which includes family caregivers, professional caregivers, doctors, nurses, and patients, was 2,955. The approximate ratio of time used by the main user groups—patients, doctors, nurses, and family caregivers—was 4:4:4:1. Caregivers used the system during the tele-education service for a limited time (approximately 20 h). Major technical problems that resulted in canceling the scheduled service occurred five times over 2 years, and four occurred before August 1997. Three episodes involved communication equipment errors, and two were software errors.

Acceptance by Users and Consistency in Clinical Assessment

The detailed observation on the acceptance of our system by dementia patients showed that they responded with slightly tense and frightened facial expressions in the beginning and with more comfortable ones as they

TABLE 1. Subjects who received telemedicine and tele-education services via the telemedicine system for 2 years (from 1997 to 1998)

| | Elderly welfare center | | Nursing home | Total |
|---------------------|------------------------|----------|--------------|-------|
| | Day care center | TSU(OPD) | | |
| Registered patients | 28 | 59 | 53 | 140 |
| Family caregivers* | 381 | 239 | — | 620 |
| Care personnel* | — | — | 140 | 140 |

*Cumulative number.
TSU(OPD), Telemedicine Service Unit for outpatients.

became acquainted with the doctors at the DTC within at least several sessions of the telemedicine service. Even dementia patients with severe cognitive impairments could respond to the familiar face or voice of the doctor according to repeated interviews, i.e., nonverbal communication was certainly possible via our system. The acceptance by family caregivers and nurses was better because of their easy adaptability to the system and no existence of visual or hearing impairments, which are not uncommon in the elderly. It took only a few weeks for the nurses at the recipient sites to become accustomed to operating the system. Because they were able to correct the input data up until each record of each patient was completed, the nurses felt relatively comfortable in collecting and inputting the data. They were highly satisfied with teleconferencing with the doctor at the DTC in detail for each patient. The general acceptance of the system by the patients in the nursing home was similar to that in the day care center, excluding those with severe visual or hearing impairment.

The consistency rates in the scores of the BDS, SBT, and CDR scale between the assessment via the telemedicine system and in-person assessment are shown in Table 2. In both recipient sites, these scores were identical in 76% to 89% of the patients between two assessments. Although the differential diagnoses of dementia between the assessments were not identical in all cases (82.4%), as is shown in Table 2, the consistency rate of having a diagnosis of dementia was 100% in both sites. The BDS, SBT, and CDR scores assessed via our system were highly correlated with those by in-person assessment (Pearson correlation coefficients: 0.980, $p < 0.001$ for BDS; 0.956, $p < 0.001$ for SBT; 0.928, $p < 0.001$ for CDR).

Clinical Outcome in Telemedicine Service

The telemedicine service to the elderly welfare center was provided primarily for dementia patients at the day

TABLE 2. Subjects with the consistency between the assessment via the telemedicine system and in-person assessment

| | Elderly welfare center (day care center) | Nursing home |
|-----------|---|--------------|
| BDS | 6 (0.5) | 7 (0.5–2) |
| SBT | 6 (8) | 9 |
| CDR | 5 (1) | 9 (1) |
| Diagnosis | 6 | 8 |

Values in parenthesis indicate range of score difference between video assessment and in-person assessment.

BDS, Blessed Dementia Scale; SBT, Short Blessed Test; CDR, Clinical Dementia Rating scale.

care center and secondarily for the demented elderly living in the community. Clinical characteristics, including the diagnoses of the patients according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders (4th edition) and the mean scores of the Korean version of Mini-Mental State Examination, are summarized in Table 3. Six-month follow-up data on the Zarit Burden Interview was available in only 8 of 23 registered patients from the day care center and showed the relative decrease of caregiver burden in 4 patients after administering cognitive enhancers and/or antipsychotics (Table 4).

Among 59 registered patients from the TSU(OPD), some visited the Dementia Clinic at SNUH to undergo laboratory or neuroimaging tests and detailed neurologic examinations for the diagnostic work-up of dementia. Only 7% of registered patients received continuous follow-up evaluation via our system (Table 4).

As shown in Table 3, we often had some difficulty in making accurate diagnoses for patients in the nursing home, mainly because most of these patients had no reliable informants, and the laboratory or radiologic examinations were rarely performed because of limited reimbursements. We could not obtain enough medical history information in most patients diagnosed with dementia not otherwise specified, who appeared to have other chronic psychiatric diseases. Fifty of 53 patients received antidepressants and/or antipsychotics for their depression or behavioral problems, and the mean duration of medication of 28 patients was 39.7 ± 22.7 weeks, excluding 18 patients who died and 4 who were discharged. Twenty-three patients (82%) showed a relative decrement in the mean total score of the daily behavior checklist after receiving our telemedicine service (Table 4).

TABLE 3. Clinical diagnoses of registered patients at recipient sites

| | Elderly welfare center | | |
|---------------------------------|------------------------|----------------|---------------|
| | Day care center | TSU(OPD) | Nursing home |
| MMSE-K score (mean \pm SE) | 14.2 \pm 1.3 | 11.9 \pm 0.9 | 7.1 \pm 0.7 |
| AD | 11 | 24 | 20 |
| VD | 6 | 16 | 3 |
| MD | 2 | 1 | 2 |
| PD | 1 | 0 | 0 |
| D. NOS | 3 | 5 | 20 |
| QD | 2 | 7 | 1 |
| Other* | 3 | 6 | 7 |
| Total | 28 | 59 | 53 |

AD, Alzheimer dementia; VD, vascular dementia; MD, mixed dementia; PD, dementia with Parkinson's disease; D.NOS, dementia not otherwise specified; QD, questionable dementia; TSU(OPD), Telemedicine Service unit for outpatients.

*Other psychiatric illnesses.

TABLE 4. *Clinical outcomes of registered patients from each recipient site*

| | Elderly welfare center | | Nursing home |
|--------------|------------------------|------------|--------------|
| | Day care center | TSU(OPD) | |
| Improved (%) | 61 (17/28) | 7 (4/59) | 53 (28/53) |
| Died (%) | — | — | 34 (18/53) |
| Dropout (%) | — | 93 (55/59) | |

Values in parentheses indicate no. of patients/no. of registered patients.

TSU(OPD), Telemedicine Service Unit for outpatients.

Tele-education and Telecounseling Services

Our telemedicine service for dementia patients at the day care center included the video interview with the caregivers, through which detailed counseling and management for the family were given. The total number of family caregivers at the day care center who received tele-education and telecounseling services was 381 (Table 1). In 1997, 18 series of lectures were given to 30 family caregivers at the day care center and 14 caregivers in the nursing home. The content of the lectures was for understanding of dementia and caring for dementia patients. Among 44 subjects who responded to the questionnaire for evaluating the acceptance and effectiveness of our tele-education service, 39 subjects (89%) responded that it was helpful and applicable. In comparing this service with the ordinary lecture, 14% responded that it was better, 32% that it was the same, and 54% that it was unfamiliar or boring.

DISCUSSION

The home-based care system for dementia patients, which is our final goal, could be established by way of efficient links and communications among different medical and social resources (Colenda and van Dooren, 1993). The telemedicine system can provide flexible and rapid access to remote medical expertise and resources, regardless of where the patients or relevant resources are located (Taylor, 1998). As we described in Results, our telemedicine service has been given to both dementia patients living in the community and those residing in a care facility. These patients have received treatment and care via our system without traveling to a remote specialized hospital.

We attempted to make our telemedicine system work as the core of our provisional model of the care system for dementia patients. We also established the network of registry and information services for dementia patients to promote an efficient home-based care system for them. We applied another care modality to the long-term care

facility, where the lack of continuous medical care by specialists and caring by untrained nurses are most problematic. Our telemedicine system has provided psychiatric service, which was not present in the long-term care facility, and improved the existing service.

Acceptance and Consistency in Clinical Assessment

Although telecommunication technology has been available in the mental health care field for more than four decades, it remains rarely used for assessment or treatment of psychiatric disorders. A previous study on the reliability of video interviews for patients with obsessive compulsive disorder showed no difference in the interrater reliability compared with that of in-person interviews (Baer et al., 1995). In schizophrenic patients, reliability in establishing the diagnosis or in assessing the symptoms by rating scales and their acceptance was also demonstrated (Zarate et al., 1997). The relatively good acceptance of our system by dementia patients and family caregivers was recognized based on their positive emotional responses. However, another survey that more closely evaluates user satisfaction of our telemedicine service needs to be conducted (Blackmon et al., 1997).

In our interactive videoconferencing system, near real-time transmission of the image and sound occurred, and jerky motions rarely appeared on the screen because of its higher bandwidth. Therefore, the system would be highly applicable in psychiatry, considering the importance of assessing patients by both verbal and nonverbal communications. A previous study of a videoconferencing system showed that the Cambridge Cognitive Examination can be used reliably without major modification (Ball and Puffett, 1998). In a recent case study on cognitive behavior therapy via interactive video, anticipated difficulties in nonverbal communication were not experienced (Manchanda and McLaren, 1998). Our results showed there are relatively high consistency rates in the scores of the rating scales of cognition and dementia severity and in the diagnosis between assessment via our telemedicine system and in-person assessment, suggesting that assessment of dementia patients via our system is relatively reliable. However, there is some limitation in interpreting reliability in our study, because we did not assess the same patient during the telemedicine service simultaneously by two raters: one at the DTC and the other at the remote site (Baer et al., 1995).

Clinical Outcome

In developing a model of telemedicine service, the important perspectives are the nature of the service and the role in a framework of health care provision, which

we discussed in the previous section. Another aspect in the telemedicine research is studying the effects of the telemedicine service, which include the clinical improvement, satisfaction of service, and cost reduction (Taylor, 1998).

As shown in Table 4, in the nursing home, we found that the behavioral symptoms of dementia patients were relatively improved by our telemedicine service, with administration of antidepressants or antipsychotics. This symptomatic improvement suggests that it could also provide some benefits to patients with other psychiatric diseases. We recently began a more structured assessment of behavioral symptoms by the Behavioral Rating Scale for Dementia to consolidate the aforementioned result (Tariot et al., 1995).

For the demented elderly in the community, the TSU(OPD) played a complementary role in the assessment of dementia; the patients usually needed to visit the Dementia Clinic in SNUH after their initial use of the telemedicine service. The high dropout rate here could be explained by the understanding and attitude of families to the demented elderly in our country. The folk term *no-mang* (senescent forgetfulness) has been used for dementia in Korea, implying that dementia is a manifestation of memory disturbances in normal aging. This may have resulted in the family giving up or neglecting the medical care for the demented elderly from the beginning (Lee and Woo, 1998). On the other hand, the extension of our telemedicine service to the elderly in the community would be still useful for education on other geriatric diseases. In addition, the early detection of dementia could be facilitated with easy accessibility to the specialist and a rapid screening process via our system (Jones and Colenda, 1997).

Cost-Effectiveness

In evaluating the cost-effectiveness of the telemedicine system, the cost of project establishment, equipment, maintenance, communication, and staffing should be considered (Crowe, 1998). The project establishment cost is usually difficult to calculate in most telemedicine systems, including ours. The communication cost in our system has not been high based on its national fare, but will become five times higher if the public fare is applied. To maintain its cost as the national fare, government policy will be essential. The indirect cost reduction can occur according to the diminished rate of admission into long-term care facilities and the cost reduction in transporting the patients and using conventional medical resources (Dwyer, 1973; Starker et al., 1976; Meltzer, 1997). The precise estimation of these costs seems to be difficult. Nevertheless, further study on more compre-

hensive cost-effectiveness is required for our telemedicine system. It would be critical in deciding whether the financial support from the government for our system will be continued (Parednia and Allen, 1995).

In summary, our telemedicine system seems to be a reliable modality for dementia assessment and effective for care of dementia patients. It could be a model system, integrating medical and social care for dementia patients. Another advantage of this system is increasing accessibility to the psychiatric service. The systematic tele-education service was not provided enough to evaluate its quality in our study. However, the possibility of developing various tele-education programs for the nurses and caregivers for dementia patients was suggested (Ball, 1996).

The most important issue in our future is that we continuously promote our telemedicine system as a core model of the home-based care system for dementia patients. Because the outcome at the TSU(OPD) was not successful in our study, it would be essential to focus on the continuous care for dementia patients rather than the diagnostic assessment itself. We also suggest that teleconsultation on other geriatric diseases be provided via our system. Other remaining important issues to be resolved are the legal support for the medical liability of the telemedicine service and its reimbursement policy (Covina and Hardy Havens, 1996).

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