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□ Review □

Telemedicine in Long-Term Care
-An Example of a Nursing Home System-

Jung Yong Park*, Jeanette M. Daly**, Gerald J. Jogerst***

*Fellow Physician Researcher, Department of Family Medicine, 01105-C PFP
200 Hawkins Drive University of Iowa Iowa City, Iowa 52240,
**Geriatric Nurse Researcher, Department of Family Medicine, University of Iowa,
***Associate Professor, Department of Family Medicine, University of Iowa

THE INTRODUCTION

Telemedicine had its beginnings in the United States in the 1960s as a means of providing specialty consultation using closed circuit interactive television.[1] With the explosion of interest in telemedicine over the past five or six years there has been an increase in the use of telecommunications technology. At present telemedicine is used by a growing number of health providers and home health care services.[2] But it's use in long-term care has not been explored.

By the early 1990s, dramatic improvements in information and communications technology heralded the dawn of a new era for telemedicine. It is 10 years since the resurgence of interest in telemedicine. The technology has undergone considerable development: the cost of equipment and communications has declined substantially; a wide range of applications has been deployed; telemedicine has been used in a variety of unique and extreme environments; the quality of the published literature on telemedicine has improved; and administrators have more realistic ideas about how to plan and use the technology. Even with these improvements, there has been slow progress in the areas of payment coverage and for services.[3]

Correspondence: Jung-Yong Park, Department of Family Medicine, 01105-C PFP 200 Hawkins Drive University of Iowa Iowa City, Tel: 319-353-5552, E-mail: jung-yong-park@uiowa.edu

There are still problems with the use of telemedicine. High costs, cumbersome equipment, network speed, security, and reimbursement for services are some of the imminent problems. Most of all the infrequent use was the big barrier to diffusion of this system. Telemedicine focus has predominantly (67%) been tele-radiology in rural hospitals with about one consult done per day. In recent years telemedicine has expanded into dermatology, cardiology, oncology, and neurology.[4] A nursing home telemedicine system could be more than this. Using telemedicine by primary care physicians may provide benefits for the physician and the special field of telemedicine. The usage frequency has the potential to be higher and thus may be more cost effective. In addition to the family physician using the system, they can make appropriate referrals and other specialist have the ability to use the system. Another advantage of the telemedicine system for residents of nursing homes is they have more health care needs and there is staff available around the clock to facilitate use of the system.

THE MAIN DISCLOSURE

1. Need of Telemedicine in Nursing Homes

When a resident in long-term care has a health crisis that is not resolvable by nursing, they need to be seen by a physician or transported to an emergency

department. If it is not an acute emergency, the physician can visit the resident in the long-term care setting. As well, if an oral health problem occurs, the staff must either take the resident to a dental office or arrange for a dentist to visit the facility. In any of these scenarios, there is a burden placed on the resident and their families with resulting trauma from the health crisis, relocation, and cost of service. Everyone involved incurs time and monetary cost during a health care crisis.

During relocation, a catastrophic reaction may occur. Frail elderly residents with mental impairment have varying degrees of intellectual defects that involve memory, cognition, language, visuospatial skills, and personality resulting in social and physical dysfunction. Familiar visual cues are no longer present with relocation. The person may become anxious, agitated and disruptive in the changed environment.[5] Most antecedents of aggression occur in response to some environmental stimuli.[5,6] Wandering, elopement, irritability, combativeness, and noisiness are other common responses that may occur to someone who has been relocated. Elderly are prone to relocation stress and this impacts an estimated 25% to 49% of long-term care residents who are hospitalized each year.[8-11]

In addition to cognitive impairments, the frail elderly resident with physical impairments have varying degrees of motor inability. The majority of residents in long-term care are dependent on staff for transfer abilities.[12] A trip to a physician's office or the emergency department is hindered by poor mobility. Often times, staff or family cannot transfer the patient and an ambulance or specialized transport services are necessary. The elderly are taken to the hospital for many reasons such as: fever, infections, surgical problems, diseases of the circulatory, respiratory, and genito-urinary systems, altered mental status, and needing tube replacement.[13-17] Barker, Zimmer, Hall, et al[7], have found that not having on-site medical staff is a predictor of hospitalization.

A trip to the emergency department and potential hospitalization are costly for residents residing in long-term care. Many iatrogenic problems such as falls, incontinence, dehydration, nosocomial infections, adverse drug effects, and delirium befall residents who are admitted to the hospital. Those who are admitted to the hospital often develop pressure sores[17], which are expensive to treat and may lead to death.[18] Because of the relocation impact, it is advantageous to keep residents in their own familiar setting.

Elderly persons, including residents of nursing homes, use the emergency room in greater proportion than the general population and arrive by ambulance more often than others.[19-21] Elderly persons are admitted to the hospital from the emergency room 45% of the time compared to 18% for younger individuals.[22] An increase in the admission rate from the emergency department has been seen in elderly patients; up to 46% in 1995 from 32% in 1990.[21] In 1995, approximately 16% of 100 million U.S. emergency department visits were the elderly.[21] Another problem encountered by the elderly during an emergency department visit is sub-optimal medication selection.[23]

Results of a project exploring health care of individuals visiting an emergency department, found that 52% of those visiting the emergency department had non-urgent problems. A recommendation from the study was "elderly residents in long-term care also are in need of new ways to prevent problems that are commonly treated in the emergency department".[24] Saliba and associates[25] demonstrated poor quality of care was associated closely with inappropriate hospitalization. They found that 36% of emergency department transfers and 40% hospitalizations were inappropriate for long term care residents.

2. Idea for Development

A telemedicine system for use in long-term care was conceived with input from a development team at the University of Iowa. The team consisted of a geriatrician, nurse, physician, two engineers, and the support of Samsung SDS.

In June 2000, letters were sent to information technology companies discussing the idea of partnering to develop a telemedicine system for nursing homes. Responses were received from a few companies and meetings to explore options were held. One significant response to the letter was from Samsung SDS of Korea.

Meetings and negotiations led to a contract between the Department of Family Medicine and Samsung SDS that provided for two engineers to come to the University and work with Dr. Jogerst, Dr. Park, and Dr. Daly. In March 2001, Y.D. Kang and T.H. Bae arrived at the University of Iowa to begin the project. A year later the e-TeleHealth™ system is ready for the pilot phase.

3. Nursing Home Telehealth System

The nursing home telehealth system described here has been branded as e-TeleHealth™. e-TeleHealth™ is a rollabout system that houses electronic equipment including a computer, monitor on a moveable arm, video-conferencing system (See Figure 1). It also includes an electronic stethoscope, otoscope, dermascope, dentalscope, and EKG (See Figure 2). The transmission for the rollabout is a wireless network system and the equipment can be plugged into any electrical outlet. The rollabout was developed to move around in the nursing home taking it to the bedside of the resident with problems.

The system provides full interactive live video and audio capacity. A physician or dentist can be in their office or home and access the e-TeleHealth™ web site with their own personal computer system to carry out a live telehealth visit. The nursing home telehealth system hardware configuration consists of two units: the base station unit at the nursing home and a consultant's unit. The consultant's unit is used at the consulting provider's end (physician, dentist, pharmacist, etc.). At the facility, the base station unit includes the rollabout, information management program for the resident's data, and the network for broadband Internet. The base station can accept variable Internet lines such as cable modem, Digital Subscriber Line (DSL), T-carrier system (FT1, T1) or a satellite Internet (see Figure 3). At the consulting provider's end it includes a computer with a videoconferencing system, stethoscope receiver and Internet connection (preference is for a broadband Internet line) for the e-TeleHealth™ program.

Each piece of equipment on the rollabout operates independently of the other. The otoscope, dermascope and dental scope are connected to a main unit that provides a light source that is easily adjusted for illumination. There is a focus mechanism on the device and for safety there is a ear protective cap to

Figure 1. e-TeleHealth™ (Rollabout with Electronic Equipment).

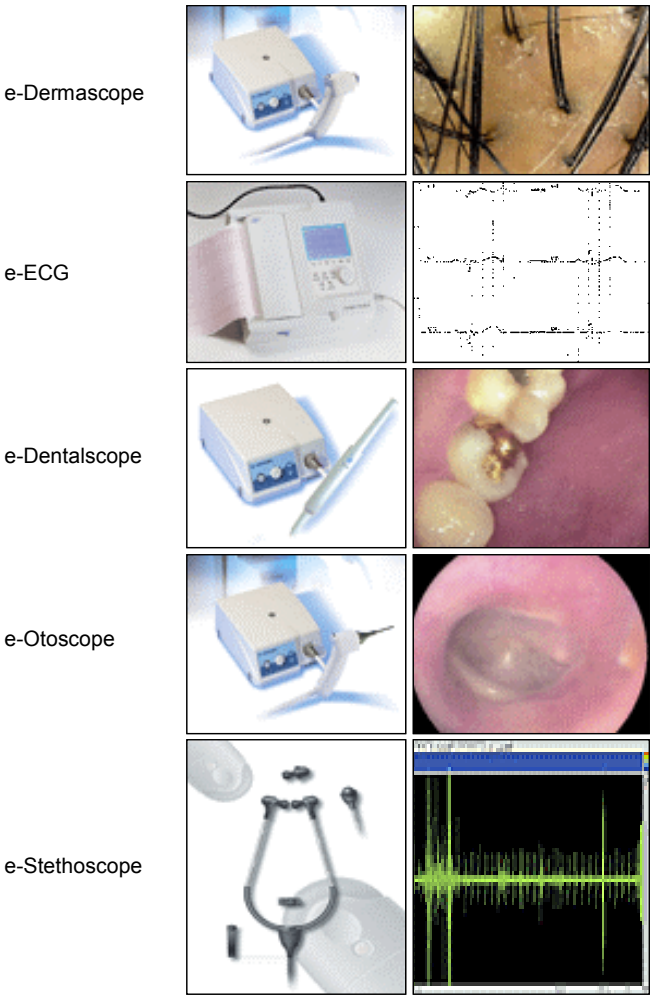

Figure 2. Electronic medical equipment and captured images.

place on the end of the otoscope. The 12-lead ECG has the operation modes of monitoring, recording and copying. Its application is the same as other ECG machines.

4. Uses for e-TeleHealth™

The e-TeleHealth™ system can be used for a variety of purposes by any health care professional. One obvious use is for a physician/patient visit. Rules and regulations for frequency of physician visits state the resident must be seen at least once every 30 days for the first 90 days after admission and then at least once every 60 days thereafter.[26] A potential use of this e-TeleHealth™ system would be the required physician visit.

e-TeleHealth™ could revolutionize care for residents residing in long-term care facilities. Imagine hearing abnormal lung sounds in the morning, and by afternoon, the resident has been seen through the Internet by a physician, and medication has been

Figure 3. Rollabout in the nursing home and internet connection.

ordered and given. Imagine capturing on video your frequent faller's fall and transmitting that video to the physician and physical therapist. Imagine a wound clinic scheduled with an enterostomal therapist and recommendations for wound care received on a frequent basis. Imagine a family wanting to see their loved ones every day even though they are thousand of miles away and could do that with a camera in the activity room. Imagine a Speech Therapist observing mealtime to uncover any eating problems. Imagine families and physicians attending care plan meetings from a distance. All this and more could be possible with the e-TeleHealth^{TM} system.

Following are some examples for which a telehealth visit could be used.

1) Mrs. J had just been seen by her physician for her regular two-month nursing home visit when three days later she developed a rash over her entire body. She complained of feeling uncomfortable and was scratching herself. The nurse connected the e-TeleHealth^{TM} system with the physician and he assesses her skin with the dermascope. It was determined she was allergic to the new detergent in the laundry. Orders were received to provide comfort for her.

2) A 100 year-old resident unable to participate in any of her care complained of pain when chewing food and when she drank cold liquids. This was a new problem for her. She hadn't been outside the facility for a number of years and her family physician had just been in to visit her last week. An oral examination via the telehealth system by her physician could confirm if she needed a dentist to evaluate the pain or if another problem was evident.

3) Mr. P a permanent resident in the nursing home had short term memory problems. In the evening, he became very confused and did not communicate as usual. His vital signs were evaluated and he had a

slight fever and non-productive cough. The nurse listened to his lung sounds and realized they were diminished. She connected the live telehealth system with the physician and he was able to complete a physical assessment including auscultation of the lungs using the electronic stethoscope. Mr. P was diagnosed with pneumonia and treatment prescribed with the resident not having to make a trip to the emergency department.

4) Mr. J who moves about the nursing home in a wheelchair incurred a fall lacerating his arm. He wasn't sure how he had done it but there was blood on the door latch. A live video call would allow the physician to determine if sutures are necessary and a transport may not be necessary.

5) Mrs. S was a permanent resident of the nursing home because she had dementia. She was able to do her own activities of daily living with observation and would socialize with residents and staff throughout the day. She was used to coming and going as she pleased. One day she complained of a rapid heart rate and shortness of breath. She had no energy and was unable to do her routine care. The nurse contacted her physician and set up the EKG. The physician observed the atrial fibrillation immediately and treatment was initiated.[27]

6) Mr. D, a resident with dementia, was physically violent during any personal cares. He would hit, kick, and spit at the staff as he was bathed, dressed, or transferred. The staff at the nursing facility had attempted different types of baths: bed bath, shower, and whirlpool, different interventions for dressing and transferring. In each instance Mr. D was uncooperative and no one method seemed better than the other. The staff recorded the behavior during the different bathing, dressing, and transferring methods. They used the store and forward mechanism and transferred the data to the consulting gero-psychiatrist for evaluation.

THE CONCLUSION

Kavesh and Bachrack[28] poignantly report the trials of instituting the Boston City Hospital Telemedicine program. Their project had to conform to rules and regulations of the Medicaid and Medicare agencies. Waivers were received to allow nurse practitioners and physician assistants to prescribe in nursing homes. The telemedicine component of this project consisted of the telephone and a beeper system. One important finding of this study was that on-site physician assistants and nurse practitioners decreased the need for emergency care for residents. Intrator, Castle, and Mor[29] had similar findings that the presence of nurse practitioners and physician assistants in the nursing homes reduced the risk of hospitalization by 41%. They also noted the availability of diagnostic resources, such as x-ray equipment and an on-site laboratory might also facilitate the decision to keep the patient in the nursing home. Keeping residents at their place of residence would also reduce the relocation problems.

This is the first telehealth system developed specifically for use in long term care facilities. Demonstrations of the e-teleHealth™ system are ongoing at this time. Obstacles to implementation include cost for Internet installation, monthly connection fees, and initial outlay for equipment. Not all facilities have the capability of receiving high-speed Internet connection, and lack of reimbursement for providers using the telehealth system in nursing facilities further hamper the implementation. Unique features about this system are that it is a totally wireless rollabout system, using a web based program, and easily modifiable for the customers needs. The equipment on the rollabout can be configured for the individual needs of an institution.

Telemedicine systems are particularly attractive for special populations and areas that are not easily

accessible. Populations difficult to maintain standards for medical care as those residing in nursing homes or penitentiaries could benefit from this system especially if they are located in remote settings. Cost effectiveness of telemedicine in all these situations has not been determined as compared with traditional face-to-face physician visits. But it is very clear that the telemedicine system is not as expensive or cumbersome as the alternatives that is extensive escorted ambulance or jammed traffic journeys, air-sea rescue services, or emergency landings.

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