Application of Technology ■

Implementation of In-home Telemedicine in Rural Kansas: Answering an Elderly Patient's Needs

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A b s t r a c t   The Interactive Home Health Care Program is a demonstration project evaluating the use of in-home telemedicine to provide health care for elderly and disabled people. Local cable systems interconnect a base station staffed by a telemedicine nurse with a modified television in the home. Six months into the project, 38 patients are being cared for at three sites in rural Kansas. Individual patient profiles show improvement. Technical and social challenges appear solvable. An evaluation is in progress.

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Located in Ellis County in the northwestern part of Kansas, Hays Medical Center is the only secondary care center in the area and therefore serves 27 rural counties. Ellis County's population currently stands at 26,004, with 4,547 people (17.5%) over the age of 65. In the surrounding counties in northwest Kansas, 9% to 27% of the population are older than 65. Given the sparse population and rural setting, people in this region view telemedicine as a necessity rather than a technologic novelty. Eight area hospitals have implemented teleradiology programs via T1 lines. Interactive television connects the emergency departments of both the Kansas University Medical Center and Hays Medical Center to a number of rural sites in the region. Store-and-forward technology is used in a tele-oncology program. The latest addition to the area's telemedicine programs is the Interactive Home Health Program, providing health care in the elderly patient's home.

The central objective of the Interactive Home Health Care Program is to demonstrate an alternative and effective means of providing health care for elderly and disabled people that can reduce the need for other health services and prevent premature institutionalization in long-term care facilities. This paper describes the program and the range of technical and social problems that must be resolved in the course of establishing telemedicine services in the homes of elderly patients with declining physical and mental conditions.

Program Description

The Interactive Home Health Care Program was started with a grant from the Kansas Health Foundation. It was expanded in the fall of 1995 by a major matching grant from the Telecommunications and Infrastructure Assistance Program of the United States Department of Commerce's National Telecommunications and Information Agency. The grant project includes Hays, Atwood, and Lawrence, Kansas, with 15 patients at each site. The Veterans' Administration (VA) Hospital in Kansas City, Missouri, is being added to the project to allow comparison of the use of in-home telemedicine in rural and urban environments.

There are 38 patients being seen weekly in the three rural Kansas sites. The VA hospital site will add an additional 15 patients. The patients receiving care via the Interactive Home Health Care Program have a variety of diseases and conditions common in the homebound or partially homebound elderly and disabled populations. The conditions include chronic obstructive pulmonary disease, diabetes, Parkinson's disease,

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chronic depression, and emphysema. Recruiting patients to a new program is always difficult, but it is especially difficult in a rural area in which the number of willing elderly patients who meet the selection criteria is limited. In small communities, excluding certain patients also can have political ramifications that are detrimental to the project and its further growth. For these reasons, the patient selection criteria for this program are reasonably broad. (Table 1 lists the inclusionary and exclusionary selection criteria.)

At each project site, nurses see patients via telemedicine visits at regularly scheduled times during the week. Because of the variety of conditions involved, some patients are seen from one to three times daily and others from one to three times weekly. In order to reduce the number of variables in the experimental design, patients are seen only by the telemedicine nurse or someone the nurse assigns. When a home intervention is required to draw blood, change dressings, or care for wounds, the telemedicine nurse makes the visit or assigns a home health nurse to make the visit.

There are four registered nurses assigned to the project, one in each of the four project sites. Significant nursing time has been spent at each site on program education, equipment installation, and patient assessment. The nurses are based on two rural hospitals, a nursing home facility, and the VA Hospital in Kansas City, Missouri. Each of the three rural sites has a restricted telemedicine service area due to the limitations of its local cable television system. The VA Hospital will be using integrated services digital network (ISDN) services because of problems encountered in negotiations with its local cable company.

The Interactive Home Health Care system provides full interactive video and audio capacity between the elderly patients in their homes and the telemedicine nurse. In addition, the nurse can view and enter patient data. The system allows monitoring of blood pressure, medication, diabetic condition, diet, hygiene, and mental health status. The system consists of two units: the base station unit used by the telemedicine nurse and the home unit used by the patient in his or her home.

A primary requirement for the HELP innovation's ResourceLink base station was the ability to accept multiple transmission media—cable, ISDN, plain old telephone service (POTS) (Table 2)—and to adapt to emerging technologies. The base station consists of a high-speed computer with ZIP drive, a video camera, a color monitor, and a headset to allow interactive audio/video communications between nurse and patient.

Table 1 ■

Inclusionary and Exclusionary Selection Criteria

Inclusionary criteria

YES	NO	
___	___	A. Involvement of a physician who will approve the plan of care.
___	___	B. Residence within the geographic service area.
___	___	C. Two of the following: 　1. Two or more chronic medical problems. 　2. Four or more prescription medicines. 　3. Two or more hospitalizations in the past 12 months. 　OR 　4. Referred for supportive services in the past 6 months.
___	___	D. Informed consent.
___	___	E. Able to follow directions.
___	___	F. Able to position self in front of monitor.

Exclusionary criteria

YES	NO	
___	___	A. Terminal condition of less than 6 months.
___	___	B. Requires daily skilled invasive procedures by a nurse.

If the patient is considered as a candidate for inclusion in the program, the patient will be evaluated on the following criteria during a home interview designed to provide information about the program.

The system's patient management software is a proprietary product developed in Microsoft Access in a relational format that will allow for upward migration to Windows NT or UNIX and for the integration of other health care systems' databases. The software includes the following components:

- A complete patient file, incorporating a detailed patient assessment as approved by the US Health Care Financing Administration (HCFA). The patient assessment includes information on social support, functional capacity, current medications, a review of health and nutritional status, body systems, communication level, cognitive and behavioral status, and a review of the home environment, including home and financial management.

- Clinical protocols and pathways

- Physician's orders, including acceptable parameters for vital signs and special noting if patient data exceed those limits

- Task lists, documentation standards, and visit reports

- Resource information

Since patients are familiar with television, the in-home patient station was designed around this medium. The patient unit consists of a 13-inch color television

with a video camera affixed to the top. The unit has no dials, buttons, or keyboards, and all proprietary modifications are contained within the monitor. After receiving a "beep" from the unit at 2 minutes before the agreed-upon appointment time, the patient simply sits in front of the unit. The patient's picture and voice are transmitted to the nurse's base station simultaneously as the telemedicine nurse's picture and audio are being received by the patient unit.

Status Report

Although in a very early stage, the Interactive Home Health Care Program has had some initial successes that are felt to be representative of the project's future.

A 65-year-old woman with diabetes, bipolar disorder, high blood pressure and manic-depressive disorder had been hospitalized multiple times for either hyperglycemia (blood sugar level too high) or hypoglycemia (blood sugar level too low). Psychiatric problems usually followed each of these episodes. The patient has been in the program now since June 1996. The telemedicine nurse has now been monitoring the patient's insulin injections morning, noon, and night. At the start of the visits, the patient's blood sugar readings ranged from 100 to 500 mg/dL. In the second week of her care plan, the range was 100 to 375 mg/dL. She is now averaging 225 mg/dL. There have been no further hospitalizations.

A 70-year-old man with laryngeal cancer whose voice box had been removed had serious postoperative agitation and aggressive behavior problems. As a result, the manager of the senior apartment facility where the patient was residing had decided that the patient would have to vacate his apartment and move into a state nursing home. Before that could happen, however, the patient was enrolled in the Interactive Home Health Care Program. The telemedicine nurse now sees the patient morning and night to be sure that the proper medications are being taken. There have been no outbursts or other problems for 2 weeks, and the patient will now be allowed to stay in his apartment and will not be moved into a nursing home.

A 71-year-old man with multiple conditions used to require the home health aid to dress and groom him. Since entering the Interactive Home Health Care Program, the patient perceives himself as being on television. He is now up every morning, dressed and groomed for his visit with his telemedicine nurse.

In general, many of the female patients who were not usually awake in the mornings are now up, dressed, groomed, and ready for the interaction. They are beginning to treat the telemedicine visit as an event that they look forward to each day.

Early results have also pointed out problems that must be overcome. Adequate sound quality appears to be extremely important and technically difficult to achieve. We were originally concerned that the quality of visual units would be such that syringes, medication labels, glucometers, and blood pressure meters would be readable, and so we paid little attention to the audio quality. We found that the digital audio-loop was causing a deterioration in the sound quality. Many of our patients already had trouble understanding an individual in the same room with them. It was almost impossible for them to understand what was being said to them over the system. The quality of the audio has now been improved and is no longer a problem.

Kansas University Medical Center has completed the evaluation research model that is being used at all four sites. The model was entered into a relational database. The telemedicine nurse using the system has found the computerized data collection process to be awkward and time consuming. Although the questions are relevant and well thought out, the manner in which the nurse is expected to answer them is cum-

Table 2 ■

Advantages and Disadvantages of Various Modes of Transmission

Coaxial Cable/Fiber Optic Cable	ISDN	POTS
(+) Broadcast-quality video (30 frames per second) and audio	(+) Technologic advances are producing video which appears near full motion while only 15 frames per second with audio synchronized within 1.5 sec.	(−) Advancement in technology expected to be slow. Picture transmitted at 7 frames per second. Jerky quality, audio not synchronized
(+) Available to 85% of homes in USA		(+) Available to all homes in USA
(+) Cost effective to congregate settings		(−) Small picture (2.5″)
(+) Becoming cost effective to individual homes thru use of cable modem	(+) Available to individual homes in major cities throughout nation and becoming more ubiquitous	(−) Additional line installation required for auxiliary equipment
(−) Different states of readiness in cable systems across country	(−) Complex installation and usage fee structure	(+) Easily installed in every home, including remote rural areas
(−) Access must be negotiated with cable company	(−) Installation times vary across nation	(+) Quick installation time

Table 3 ■

Research Data Collected at Each Interaction

1. Vital signs (BP, pulse, temperature, blood glucose: Any measurement outside normal parameters?
2. Medication administration: Were all medications taken as ordered without adverse effect?
3. Mental status (alertness, effect, orientation): Has there been a change in the mental status?
4. Functional status (mobility, activity tolerance, activities of daily living, and/or instrumental activities of daily living: Has there been a change in the functional status?
5. Nutritional status: Is nutritional intake adequate and compliant with restrictions?
6. Overall health status: Has there been a significant change in overall health status?
7. Weight monitoring: Has the patient's weight changed beyond normal parameters?
8. Patient teaching: Did the patient receive instruction related to diagnosis and/or treatment?
9. Change: Was there a medication change since the last visit?
10. Change: Was there a diagnosis change since the last visit?
11. Utilization data: Emergency room visit? Yes or No.
12. Utilization data: Doctor/other outpatient visit? Yes or No.
13. Utilization data: Admission to hospital? Yes or No. Length of Stay?
14. Utilization data: Admission to nursing home? Yes or No. Length of stay?
15. Utilization data: Other health care services received? Yes or No. Describe.
16. Technical: Were there technical problems? Yes or No. Describe.
17. Visit type: Phone/onsite/televisit.
18. Visit type: Scheduled/unscheduled.
19. Visit type: Acute/chronic/both.
20. Visit data: Nurse/patient initiated.

Table 4 ■

Evaluation Plan

Part I: Descriptive analyses
  RQ1: Demographics of patient base, utilization, diagnostic categories, and unforeseen events and effects.
  RQ2: Intensity of nursing care required by patient base.
  RQ3: Describe mental, physical, and emotional status of participants.
  RQ4: Chart types, frequency, dosages, and costs of participants' medications.
  RQ5: Chart services provided (types and modalities of nursing services provided).
Part II: Satisfaction
  RQ1: Measure levels of patient's satisfaction with telehealth services.
  RQ2: Measure levels of health care provider's satisfaction in offering home telehealth services.

bersome. This appears to be a software design problem, not a problem with the questions themselves, and it needs to be corrected.

The telemedicine nursing staff has experienced some alienation and isolation due to the nature of the telemedicine job. It has been very difficult to define expectations and anticipate problems with such a completely new health care delivery mode. The nurses continue to develop new ways to use the software and to make the interactions meaningful for the patients. The core of the problems is a mismatch between the telemedicine situation and standard nursing procedures and protocols at the sites involved. There are very few models for interpreting care plans and physician orders or for actual patient care responsibility in this new telemedicine environment.

The interactive telemedicine project creates an environment that invites the telemedicine nurse to exercise greater flexibility in following care plans and to apply independent changes to normal nursing procedures. Many of the problems experienced by the telemedicine nursing staff were solved by scheduling regular meetings with the Vice-President of Nursing. This allows the telemedicine nurse to discuss specific nursing problems or to solve a patient problem that requires one nurse at the base station and another nurse at the home unit at the same time.

Program Evaluation

The Hays Medical Center's Home Health Department makes an average of 1,025 home health visits per month. The average skilled home health nurse visit costs about $60. It is estimated that the in-home telemedicine service will cost approximately $30 per visit. Kansas Social Rehabilitation Services has agreed to accept Medicaid reimbursement for the telemedicine visits. Negotiations with HCFA for Medicare reimbursement are ongoing. The proposed reimbursement structure includes differing rates for routine visits, abbreviated visits, and extended visits.

It is hoped that the comparative analysis of the patient data being collected as part of the project will lead to quality improvements and better patient and fiscal outcomes (Table 3). The evaluation of the project is being conducted by Dr. Ace Allen and Dr. Pamela Whitten of the Kansas University Medical Center's telemedicine program (Table 4).

Summary

Now in its sixth month, the project has 38 patients online at 3 sites. The system is being installed at the fourth site. Local cable systems have been very effective in creating high-quality telemedicine audio and video systems at the rural sites. Many successful patient "profiles" have showed marked improvements in specific situations. Project participants are encouraged by the daily successful use of telemedicine in the home. To date, only limited evaluation data have been collected, and speculation on it would be premature.