The Virtual Hospital: Treating Acute Infections in the Home by Telemedicine

Lawrence J. Eron MD, FACP, Michelle Marineau MSN, Ernesto Baclig MBA, Cyndee Yonehara BS, and Paula King MSN

Abstract
The growth and aging of the population of Hawaii mandates a need for more effective utilization of hospital beds. One approach is early hospital discharge and outpatient treatment. However, as the acuity of illness increases, satisfactory outcomes of outpatient treatment may be difficult to achieve. We have utilized telemedicine to closely monitor acutely ill patients with infections, such as community-acquired pneumonia, skin and soft tissue infections, and urinary tract infection, in the home setting. Our treatment paradigm achieved satisfactory outcomes, cost savings, and at the same time resulted in more rapid convalescence than hospitalization.

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talization. The patient and family members were typically anxious over this new technology and needed reassurance that they would be monitored closely in their home environment. It also allowed us to obtain a face-to-face baseline history and physical exam.

After screening, they were asked to provide written informed consent, if they were found to be acceptable for treatment by telemedicine in their home. Reasons for exclusion included an unsuitable home environment, such as homelessness or living alone, an inability to learn self-administration of intravenous antibiotics, and a lack of suitable phone lines in their house. In four cases patients refused to be treated by telemedicine because of a lack of familiarity with, or fear of, computer technology.

Once they agreed to treatment by telemedicine in the home, a member of the telemedicine team met them in their home to set up and instruct them or a family member, friend, or neighbor, in the use of the equipment. The first televisit was then conducted between the patient in the home (in the presence of the telemedicine team member) and a clinician at the central station in the hospital (either a physician or a nurse practitioner trained in the management of these types of infections). After demonstrating a televisit, the telemedicine team member in the home observed the patient's technique. Once patients mastered the application of the blood pressure cuff to their arm, the stethoscope to their chest, and the pulse oximeter to their finger, they managed subsequent visits faultlessly. Problems encountered involved suboptimal lighting or excessive movement of the patient, which resulted in fragmentation of images due to excessive pixelation. The best lighting was indirect without any back-lighting.

The initial televisit usually lasted for one hour, subsequent followup visits 15 minutes, during which time patients in their home and the clinician at the central station were able to see each other and converse. The clinician at the central station was able to determine the patients' clinical status by auscultating their lungs, and monitoring their blood pressure, heart rate, respiratory rate, temperature, and oxygen saturation. With the loss of face-to-face encounters, strategies for meeting other family members and pets and for commenting on the patient's home surroundings while conducting televisits, assisted in gaining the patients' and the families' confidence and trust. Most patients televisit once daily, but for patients with more severe illnesses, televisits can be conducted several times daily.

When patients improved to the point where they would normally be discharged from the hospital, patient stations were removed from homes. Should a patient's clinical status have deteriorated at any time, he was instructed to either call a member of the telemedicine team or return to the hospital.

Results of a pilot trial:

We have reported the outcomes of a trial of telemedicine in the home in which we treated 25 patients6. The types of patients that were treated are illustrated by the four examples in Table 2. We compared patients treated by telemedicine in the home in a case control fashion to a comparable control group of hospitalized patients. While the large majority of patients in each group were cured, those treated with telemedicine in the home recovered at a more rapid rate, as judged by their earlier return to their normal activities of daily living.

Through the use of telemedicine, we were able to accomplish five things.

• The patient could be monitored several times a day, as if he were in the hospital.

• The patient was reassured by maintaining audiovisual contact with his health care providers.

• More efficient bed utilization was accomplished by discharging hospitalized patients earlier than would otherwise have been possible, and in some cases avoiding hospitalization altogether.

• The patient felt more comfortable at home than in the hospital.

• Based on our prior experience 6,10 and that of others,11 patients who were managed as outpatients returned to their normal activities of daily living more rapidly than comparable patients who were hospitalized.
Technical problems:
We experienced several problems that must be overcome before telemedicine in the home can be widely deployed. First and foremost is that of technical problems, such as poor video images and freeze-ups. This problem is caused by low bandwidth (a measure of the amount of information that can be transmitted over a telecommunication line) of POTS. Equipment offered by the major home telemedicine vendors is, for the most part, POTS-based. The low-bandwidth of POTS connections did not consistently support the minimum telemedicine requirements of two-way video and audio connections plus one-way data transmission of patients' vital signs. With the broadband connections via cable, DSL, and Wi-Fi, that are becoming commonplace, there is now sufficient, available bandwidth to allow for higher-quality video and audio connections that could vastly improve televisits. Moreover, once the telemedicine vendors adopt the Internet protocol, then there will be even better flexibility in terms of mixing and matching devices, using different types of connections, and more easily moving the clinician's station between sites, such as the clinician's home and office.

The established telemedicine vendors have been slow to embrace the rapid technical advances in telecommunications of the past five years, and computer equipment vendors, whose products use the latest broadband and Internet protocol technologies, have generally been reluctant to enter the telemedicine marketplace. At the end of the day, it will be up to us, the telemedicine equipment buyers and users, to pressure vendors to move beyond POTS-based equipment, and to partner with them to develop and test new equipment.

Patient acceptance:
Patient reactions to telemedicine in the home may differ depending on age, gender, educational level, family support, and cultural factors. This may be especially true in Hawaii where there is such a diverse cultural representation. Telemedicine may not be appropriate in certain cases based on these considerations. Two examples of this are as follows: elderly patients who feel safer in a hospital environment than in the home; individuals of Philippine or Hawaiian descent who are more accepting of hospitalization and reluctant to receive treatment by telemedicine in the home.

Care-providers may in certain cases be dissatisfied with telemedicine in the home compared to hospital care for their wards. They may be unwilling to bear the entire burden of caring for a patient. It may be necessary to provide respite workers in selected cases to shop, cook, clean, bathe, and otherwise provide companionship for certain patients. This relieves a care-provider from shouldering the entire burden of a patient's care. However, it also increases the cost of telemedicine in the home.

Telemedicine is a relatively new technology that both intimidates and fascinates our patients. Once we set up a patient station in a home, family members gathered around the camera to watch the video visit. One elderly patient remarked, "It's just like when the first television set arrived in my neighborhood." We need to take advantage of this type of attitude toward telemedicine while diminishing negative reactions to it. Acceptance of telemedicine in the home will not happen overnight and will take a concerted educational program to promote it.

Clinician acceptance:
Clinician acceptance of novel treatment strategies is traditionally slow, especially if it impacts negatively on remuneration and is accompanied by extensive government regulation with attendant loss of autonomy. Most third-party insurers, especially Medicare, do not reimburse clinicians or hospitals for home televisits except to rural areas, such as the outer Hawaiian Islands. Because of this, the development of telemedicine has been retarded largely for economic reasons. Nonetheless, there are many reports of successful cost-savings and increased productivity from telemedicine trials.

There is still considerable skepticism amongst clinicians about changing the current practice of watching patients in the hospital until they are completely stable. This reaction may be based on traditional teachings, as well as clinicians' fear of an unsuccessful outcome and the potential threat of litigation. Medical-legal challenges for bad outcomes from telemedicine in the home will undoubtedly occur. However, with additional outcomes data confirming our preliminary results, telemedicine in the home will be advanced to the level of a standard of care.

Conclusion
Telemedicine in the home has several advantages over hospitalization. It promotes more efficient utilization of hospital beds resulting in cost savings. Our results would indicate that it promotes more rapid convalescence than hospitalization. How it does this is not known, although it may relate to several factors, one of which is the removal of patients from a passive, dependent posture in the hospital to being a more active participant in their own medical care at home. This may promote in patients a sense of empowerment over their illness. Whatever the reason, outcomes such as this will hasten the acceptance of telemedicine by patients, care-providers, clinicians, and insurers.

References