

Change of Patients' Perceptions of TeleHomeCare

GEORGE DEMIRIS, Ph.D., STUART M. SPEEDIE, Ph.D.,
and STANLEY FINKELSTEIN, Ph.D.

ABSTRACT

The study's objectives were to measure patients' perceptions of a telehomecare system before and after they have participated in it and identify the features of the system that patients perceived differently after experiencing it. The study setting was the TeleHomeCare Project, which uses videoconferencing and Internet equipment to enable interactions between patients and nurses. An instrument that measures perceptions of telehomecare was used. Patients viewed a videotape that demonstrates a "virtual home care visit" and filled out the questionnaire (pre-test). They were then randomly assigned to a control group receiving standard care or to an experimental group receiving videoconferencing and Internet access in addition to standard care. Both groups filled out the questionnaire when exiting the system (post-test). Paired *t*-tests were performed to compare total scores and responses to each of the items within the groups and an unpaired *t*-test was used to compare change of perceptions between groups. The control group consisted of 11 patients, and the experimental group included 17 patients. There was no statistically significant change of perception in the control group. The experimental group showed an overall more positive perception of the system after their experience (total score increase by 6.059, $p < 0.0001$), and the mean score difference was higher compared to the control group (mean 6.241, $p < 0.0001$). Elderly patients evaluated their telehomecare experience as being positive, and they felt more comfortable with the technology, believing that the nurse can understand their medical problem over the television. This suggests that telehomecare has the potential for wide acceptance among patients.

INTRODUCTION

HOME HEALTH CARE (HHC) is a fast-growing component of today's health care system in the United States and one of the potential application areas for telemedicine. HHC refers to health and social services (such as nursing, rehabilitation, social work and home health aide) provided to individuals in their home or home-like setting.¹ These services can be short- or long-term and "may supplement, complement, or substitute for institutional care."² The

number of HHC patients increased by 53% from 1992 to 1994^{3,4} in the United States and reached 7.2 million by 1996.⁵ HHC-related costs increased by 400% between 1992 and 1997. Annual expenditures for HHC were estimated to be \$36 billion in 1999.⁵

Rural and under-served urban patients often face problems in gaining access to clinical monitoring services.⁴ In addition, the number of Medicare-certified home health agencies declined in the last 2 years, and Medicare spending decreased by 32% between fiscal years 1998

and 1999⁵ as a result of changes in Medicare home health reimbursement enacted as part of the Balanced Budget Act of 1997 (BBA), which introduced a new per beneficiary limit, designed to reduce growth in Medicare home health expenditures.

Telemedicine is a method of health care delivery that could address issues of cost and access to care for rural as well as urban underserved patients. It has the potential of using technology to decrease travel time and costs for nurses and increase the number of patients a HHC nurse can serve.

Telemedicine in home care, known as "telehomecare," uses modern technology to enable the communication and the transfer of information between the health care provider at the clinical site and the patient at his/her home. The requisite technology is installed and used in the patient's home and operated by the patient. For other telemedicine applications, the patient has to travel to a nearby telemedicine site instead of a distant medical center. In telehomecare, the patients conduct their interactions with their health care providers in their own homes, just as with standard HHC visits requiring patient and/or caregiver involvement. Hence, patients must accept this arrangement for it to succeed. Patients' understanding of telehomecare will influence its level of acceptability and consequently its rate of diffusion.

Investigation of patients' perceptions of the care they are about to receive or have already received is essential in planning and delivering health care services for a population. The value-expectancy model by Linder-Pelz⁶ states that such perceptions influence satisfaction with the process of care delivery. Other models have also defined patients' satisfaction as the evaluation of congruency between expectations of care and perceptions of the care received.^{7,8}

The majority of published telemedicine studies examine patients' satisfaction after they have received telemedicine service. The findings generally reveal the level of satisfaction, but they seldom identify the attributes of the system evaluated as satisfactory, or more importantly, the general perception patients have of the system. Several studies have investigated

how patients rated specific aspects of telemedicine systems. Dick et al.,⁹ Whitten,¹⁰ and Higgins et al.,¹¹ for example, found that patients were concerned about privacy and confidentiality. Patients viewed the lack of physical contact and reduced sense of intimacy as disadvantages of telemedicine in studies by Whitten et al.,¹² Brick et al.,¹³ and Huston.¹⁴ The majority of patients in Whitten's study¹⁰ saw no immediate health benefits for themselves due to telemedicine.

The aims of this study were to measure patients' perceptions of telehomecare before and after they have experienced it and to determine which features of the concept of telehomecare were perceived differently.

MATERIALS AND METHODS

The study was conducted as part of the TeleHomeCare project at the University of Minnesota. This project⁴ uses low-cost, commercially available TV-based videoconferencing and Internet access to enable interactions between patient and health care provider (defined as "virtual visits"). It included one urban and three rural home care agencies in Minnesota, and it provided services for patients with chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and those requiring wound care (WC).

Typically, the nurse initiates a virtual visit by calling the patients at their homes. The modular videophone used for this project is the VC55 ViaTV Modular Videophone (8×8, Inc., Santa Cruz, CA), which combines with any standard video camera (with built-in microphone), a touch-tone telephone, and a TV to form an integrated videoconferencing system. The patient answers the phone, turns on the TV set, and waits for the connection to be established. As soon as the nurse can be seen on TV, the patient can start interacting without having to use the phone receiver, although some patients prefer to hold it while speaking. The videophone used for the system also includes a web browser, enabling users to access the Internet. Each patient receives individualized web pages with information related to his/her specific diagnosis.

The instrument TMPQ (Telemedicine Perception Questionnaire-copyright University of Minnesota) was used. It measures patients' perceptions of telehomecare and includes 17 items using a 5-point Likert scale. The individual scores can range from 17 to 85. The higher the total score the more positive is the overall perception a patient has of telehomecare. The development and reliability and validity testing of this instrument are described in detail elsewhere. Items were selected from a review of the literature and focus group discussions. The questionnaire was administered to a group of elderly individuals who had previously viewed a videotape describing telehomecare. The final version of the instrument used for this study showed a high reliability (Cronbach's alpha of 0.8) and evidence of validity with respect to perceptions of telehomecare.¹⁵ The items address the effect of telehomecare on quality of and access to health care, the issues of time and money (including time saving for the patient and/or the nurse, reduction of costs for the patient and/or for the health care agencies), and factors related to the conduct of a virtual visit (including ease of equipment use, equal acceptability of "virtual" and real visit, protection of privacy and confidentiality, lack of physical contact, reduced sense of intimacy, patient's ability to explain medical problems in a virtual visit). Finally, the general perception of the concept of telemedicine in home care is also addressed, including the augmentation versus substitution of standard home care as the future role of telemedicine in home care.

Items worded in a negative manner receive a reversed scoring. When, for example, a participant strongly agrees that TeleHomeCare saves money, the item receives a score of 5, whereas when a participant strongly agrees that TeleHomeCare does not increase access to care, this item receives a score of 1.

The research subjects were patients assigned to home care services in one of the three rural or the urban sites that participated in the project. Furthermore, these patients had to:

- have a primary diagnosis of CHF, COPD, or requiring WC
- be able to read and write English
- have a television and a phone in their home

- have a housing condition that enables the installation of the equipment (e.g., phone close to the television set, enough space, etc.).

Potential candidates for the project were approached by a nurse who explained the study. They also viewed a videotape that simulated a "virtual visit." The tape did not include narration or text that described TeleHomeCare. It only provided a demonstration of a "virtual" visit by showing a patient using the equipment and interacting with a nurse seen on the television screen. Patients who agreed to participate in the study signed a consent form approved by a university-affiliated institutional review board and filled out the questionnaire that measured their perceptions of telehomecare (pre-test). These perceptions were based on knowledge gained from viewing the videotape and generally available information that they may have encountered such as news stories in local newspapers or nursing staff comments or other sources.

Subsequently, patients were randomly assigned to a control group where they received standard home care services or to one of two experimental groups where they received these services with the addition of videoconferencing and Internet access and possibly monitoring devices. For the purpose of examining the effects of telehomecare on perceptions, these two experimental groups were combined. Due to the vagaries of random assignment and the combination of groups, there were 11 patients in the control group and 17 patients in the combined experimental condition. Patients in all groups filled out the questionnaire a second time (post-test) after approximately 4 weeks or at exit from home care, whichever came sooner (average elapsed days = 31.6, S.D. = 5.7, range 41–22 days). The control group completed the questionnaire again to determine if any influences other than use of telehomecare were affecting patient attitudes.

Data were gathered from both groups, before and after the experimental intervention. Kurtosis and skewness were measured and the Shapiro-Wilks test performed to assess the distributions. The data seemed to follow a normal distribution allowing the use of the *t*-statistic. Paired *t*-tests were performed to compare total

scores and responses to each of the items within the groups for the pre- and post-test and an unpaired *t*-test to compare changes of perceptions between the two groups.

RESULTS

The average age for the control group was 75.55 years (SD 12.63, *n* = 11), and for the experimental group, 76.75 (SD 12.67, *n* = 17). Five patients in the control group were male and 6 were female, whereas the experimental group consisted of 9 male and 8 female patients. No

statistical differences existed in sex, age, or diagnosis between the two groups. The pre-test scores for the two groups did not have a statistically significant difference.

The mean total score of the first test for the control group was 58.09 (SD 5.281) and of the second test (approximately 30 days after the first) was 57.9 (SD 5.205). Table 1 shows the percentages of scores for each item for both tests. There was no statistically significant change in the total scores of the control group patients for the two tests (mean difference 0.18, *t* = 0.69, *p* = 0.5059), indicating no change in perception of telehomecare for patients who had not ex-

TABLE 1. DISTRIBUTION OF SCORES FOR ALL ITEMS FOR THE CONTROL GROUP PATIENTS (*n* = 11) FOR THE PRE- AND POST-TEST

	<i>Strongly agree</i> (%)	<i>Agree</i> (%)	<i>Disagree</i> (%)	<i>Strongly disagree</i> (%)	<i>No opinion</i> (%)
A nurse can get a good understanding of my medical problem over the television.	9.09 ^a 27.27 ^b	54.55 ^a 36.36 ^b	— —	— —	36.36 ^a 36.36 ^b
TeleHomeCare can violate my privacy.	— —	45.45 ^a 36.36 ^b	— —	— —	54.55 ^a 63.64 ^b
The use of the necessary equipment seems difficult to me.	18.18 ^a 36.36 ^b	81.82 ^a 63.64 ^b	— —	— —	— —
I can be as satisfied talking to the nurse over the television as talking in person.	— 9.09 ^b	72.73 ^a 63.64 ^b	— —	9.09 ^a 9.09 ^b	18.18 ^a 18.18 ^b
TeleHomeCare can improve my general health.	9.09 ^a —	36.36 ^a 54.55 ^b	27.27 ^a 27.27 ^b	— —	27.27 ^a 18.18 ^b
TeleHomeCare can save time for the nurses.	— —	63.64 ^a 63.64 ^b	— —	— —	36.36 ^a 36.36 ^b
TeleHomeCare cannot save me any money.	— —	27.27 ^a 27.27 ^b	45.45 ^a 45.45 ^b	— —	27.27 ^a 27.27 ^b
Using TeleHomeCare the nurse will be able to monitor my condition well.	18.18 ^a 18.18 ^b	63.64 ^a 54.55 ^b	— —	— —	18.18 ^a 27.27 ^b
I don't like that there is no physical contact during a TeleHomeCare visit.	9.09 ^a 18.18 ^b	18.18 ^a 9.09 ^b	45.45 ^a 45.45 ^b	9.09 ^a 9.09 ^b	18.18 ^a 18.18 ^b
TeleHomeCare is a convenient form of health care delivery for me.	27.27 ^a 27.27 ^b	63.64 ^a 54.55 ^b	— —	— —	9.09 ^a 18.18 ^b
TeleHomeCare saves me time.	— —	72.73 ^a 72.73 ^b	9.09 ^a 9.09 ^b	— —	18.18 ^a 18.18 ^b
TeleHomeCare will be a standard way of health care delivery in the future.	27.27 ^a 18.18 ^b	54.55 ^a 63.64 ^b	— —	— —	18.18 ^a 18.18 ^b
TeleHomeCare can be an addition to the regular care I receive.	45.45 ^a 36.36 ^b	45.45 ^a 45.45 ^b	— —	— —	9.09 ^a 18.18 ^b
TeleHomeCare can reduce costs for the health care agencies.	18.18 ^a 18.18 ^b	54.55 ^a 54.55 ^b	— —	— —	27.27 ^a 27.27 ^b
A nurse cannot examine me over the television as well as in person.	9.09 ^a 9.09 ^b	45.45 ^a 45.45 ^b	27.27 ^a 18.18 ^b	— —	18.18 ^a 27.27 ^b
TeleHomeCare makes it easier for me to contact the nurse.	18.18 ^a 9.09 ^b	45.45 ^a 54.55 ^b	— —	— —	36.36 ^a 36.36 ^b
I cannot always trust the equipment to work.	9.09 ^a 9.09 ^b	45.45 ^a 45.45 ^b	9.09 ^a 9.09 ^b	— —	36.36 ^a 36.36 ^b

^aPre-test.

^bPost-test.

perceived it. Paired *t*-tests were also performed for each of the items to determine if a change between the pre- and post-scores occurred for the control group. No significant change was determined for any of the 17 items.

The mean total score for the patients of the experimental group before they had experienced telehomecare was 57.824 (SD 4.786), and after their experience was 63.882 (SD 4.846). Table 2 shows the percentages of scores for each item for both tests. There was a statistically significant change between the pre- and post-scores (mean difference of 6.059, $t = 5.667$, $p < 0.0001$), indicating that patients developed

a more positive perception of telehomecare after they experienced it.

A paired *t*-test was performed for all items to determine a possible mean difference of scores between pre- and post-test. Table 3 includes the *t*-test results for all items for the experimental group. For several items, there was a statistically significant change in the experimental group. After experience with telehomecare, there was a higher degree of agreement with the statement, "A nurse can get a good understanding of my medical problem over the television." There was a higher degree of disagreement with the notion that the equipment

TABLE 2. DISTRIBUTION OF SCORES FOR ALL ITEMS FOR THE EXPERIMENTAL GROUP (n = 17) PATIENTS FOR THE PRE- AND POST-TEST

	<i>Strongly agree</i> (%)	<i>Agree</i> (%)	<i>Disagree</i> (%)	<i>Strongly disagree</i> (%)	<i>No opinion</i> (%)
A nurse can get a good understanding of my medical problem over the television.	11.76 ^a 35.29 ^b	47.06 ^a 58.82 ^b	— —	— —	41.18 ^a 5.88 ^b
TeleHomeCare can violate my privacy.	— —	35.29 ^a 29.41 ^b	5.88 ^a 29.41 ^b	— 35.29 ^b	58.82 ^a 5.88 ^b
The use of the necessary equipment seems difficult to me.	35.29 ^a —	58.82 ^a —	— 58.82 ^b	— 35.29 ^b	5.88 ^a 5.88 ^b
I can be as satisfied talking to the nurse over the television as talking in person.	— 11.76 ^b	76.47 ^a 52.94 ^b	— 23.53 ^b	5.88 ^a —	17.65 ^a 11.76 ^b
TeleHomeCare can improve my general health.	5.88 ^a 11.76 ^b	52.94 ^a 58.82 ^b	23.53 ^a 17.65 ^b	— —	17.65 ^a 11.76 ^b
TeleHomeCare can save time for the nurses.	— 64.71 ^b	64.71 ^a 35.29 ^b	— —	— —	35.29 ^a —
TeleHomeCare cannot save me any money.	— —	23.53 ^a 23.53 ^b	29.41 ^a 29.41 ^b	5.88 ^a —	41.18 ^a 47.06 ^b
Using TeleHomeCare the nurse will be able to monitor my condition well.	17.65 ^a 17.65 ^b	64.71 ^a 70.59 ^b	— 5.88 ^b	— —	17.65 ^a 5.88 ^b
I don't like that there is no physical contact during a TeleHomeCare visit.	5.88 ^b 5.88 ^b	23.53 ^a 47.06 ^b	47.06 ^a 29.41 ^b	5.88 ^a 5.88 ^b	17.65 ^a 11.76 ^b
TeleHomeCare is a convenient form of health care delivery for me.	17.65 ^a 41.18 ^b	64.71 ^a 47.06 ^b	— 11.76 ^b	— —	17.65 ^a —
TeleHomeCare saves me time.	— —	76.47 ^a 41.18 ^b	5.88 ^a 41.18 ^b	— 5.88 ^b	17.65 ^a 11.76 ^b
TeleHomeCare will be a standard way of health care delivery in the future.	17.65 ^a 58.82 ^b	64.71 ^a 29.41 ^b	— 5.88 ^b	— —	17.65 ^a 5.88 ^b
TeleHomeCare can be an addition to the regular care I receive.	29.41 ^a 52.94 ^b	64.71 ^a 41.18 ^b	— —	— —	5.88 ^a 5.88 ^b
TeleHomeCare can reduce costs for the health care agencies.	11.76 ^a 29.41 ^b	47.06 ^a 52.94 ^b	— —	— —	41.18 ^a 17.65 ^b
A nurse cannot examine me over the television as well as in person.	11.76 ^a 5.88 ^b	47.06 ^a 23.53 ^b	23.53 47.06 ^b	— 11.76 ^b	17.65 ^a 11.76 ^b
TeleHomeCare makes it easier for me to contact the nurse.	11.76 ^a —	58.82 ^a 11.76 ^b	— 76.47 ^b	— —	29.41 ^a 11.76 ^b
I cannot always trust the equipment to work.	5.88 ^a —	41.18 ^a 5.88 ^b	11.76 ^a 58.82 ^b	— 29.41 ^b	41.18 ^a 5.88 ^b

^aPre-test.

^bPost-test.

TABLE 3. PAIRED *t*-TEST RESULTS FOR THE PRE- AND POST-TEST SCORES OF ALL ITEMS FOR THE EXPERIMENTAL GROUP PATIENTS (n = 17)

	<i>Mean difference between post- and pre-test</i>	<i>t-value (DF = 16)</i>	<i>p value</i>
A nurse can get a good understanding of my medical problem over the television.	0.588	3.405	0.0036
TeleHomeCare can violate my privacy.	1.000 ^a	2.828	0.0121
The use of the necessary equipment seems difficult to me.	2.588 ^a	13.420	<0.0001
I can be as satisfied talking to the nurse over the television as talking in person.	-0.118	-0.436	0.6684
TeleHomeCare can improve my general health.	0.235	1.074	0.2988
TeleHomeCare can save time for the nurses.	1.000	5.831	<0.0001
TeleHomeCare cannot save me any money.	-0.118	-0.356	0.7268
Using TeleHomeCare the nurse will be able to monitor my condition well.	0.00	0.00	
I don't like that there is no physical contact during a TeleHomeCare visit.	-0.412	-1.163	0.2620
TeleHomeCare is a convenient form of health care delivery for me.	0.176	0.677	0.5080
TeleHomeCare saves me time.	-0.824	-3.002	0.0084
TeleHomeCare will be a standard way of health care delivery in the future.	0.412	1.595	0.1302
TeleHomeCare can be an addition to the regular care I receive.	0.235	1.461	0.1635
TeleHomeCare can reduce costs for the health care agencies.	0.412	1.692	0.1101
A nurse cannot examine me over the television as well as in person.	0.824	2.037	0.0586
TeleHomeCare makes it easier for me to contact the nurse.	-1.471	-5.680	<0.0001
I cannot always trust the equipment to work.	1.529 ^a	5.907	<0.0001

^aScores for statements phrased as disadvantages of telehomecare were reversed; an increase in this case means a higher degree of disagreement with that statement.

An increase demonstrates a more positive perception of telehomecare and a decrease, a more negative perception. Highlighted items are the ones where a statistically significant change of scores occurred.

seems difficult for patients after they have experienced it (the scoring increased by an average of 2.588 on a 5-point Likert scale) suggesting that patients became more familiar with the equipment and, hence, rated it as less difficult to handle. Patients also seemed to have more trust in the technology at the post-test (there was an average increase of the score for item 17 of 1.529, showing more agreement at the post-test that the system saves time for nurses). There were two statements where the scoring decreased at the post-test, indicating a less positive perception of telehomecare in regard to these specific items. These were the issues of telehomecare saving time for the patient (where there was a higher degree of agreement

with that statement at the pre-test), and of telehomecare enabling the patient to contact the nurse easier. There was an average decrease in the score for that item of 1.471.

Finally, an unpaired *t*-test was performed to determine a possible difference between total score change for the control and experimental group. The difference was statistically significant. The mean increase of the total score for the experimental group was higher by 6.241 than the control group ($p < 0.0001$). This is an increase of approximately 7.34% of the maximum total score. (The total score can range from 17 to 85.)

These data demonstrate that experience with telehomecare leads to a change of patients' per-

ception and, specifically, in a more positive direction.

DISCUSSION

Investigating patient perceptions of an innovative health care delivery system before and after they have actually experienced it can enhance the detection of factors that contribute to system performance. More specifically, by measuring perceptions at two different points in time, one can determine patients' expectations of the system and their evaluation of the degree to which these were met.

The sample size for both groups in the study was not large. However, there was a statistically significant, approximately 33-fold measured difference in the mean score changes between the two groups. A post-hoc power analysis revealed that this study could detect differences of at least this size with a power of 0.83. Therefore, the findings provide useful and valid information in spite of sample size limitations. The two groups were similar at baseline before randomization with regard to sex, age, and primary diagnosis. The severity of disease was not readily available for the analysis, and, therefore, it was not investigated in this study.

The study suggested that patients tend to become more familiar with and confident in technology after participation in a telehomecare system, and the subjects seemed less concerned about telehomecare violating their privacy. These findings imply that elderly, often homebound, patients are able to handle the equipment and do increase their confidence in its use as they gain experience with it. The initial fears of some patients, like privacy, seemed to diminish. Some other original perceptions of telehomecare did not hold after exposure to the system. Although the system was described to the patients in detail, initially they seemed to view it as time-saving and as a way of having easier contact with the nurses. After actual experience of the system, where nurses initiate the videoconferencing sessions at prescheduled times, patients realized that they could not use the system to contact the nurses at any time. However,

patients felt strongly at the post-test period that this system was saving time for the nurses.

Patients' overall impression of a telehomecare system was more positive after they experienced it. They evaluated this experience as positive and beneficial for their own health as well as time saving for the nurses. They felt that a nurse could get a good understanding of their medical problem over the television and, therefore, accepted the underlying concept of telehomecare.

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Address reprint requests to:
Stuart Speedie, Ph.D.
Heath Informatics
University of Minnesota
Mayo Mail Code 511
Mayo Building
Room B608
420 Delaware Street SE
Minneapolis, MN 55455
E-mail: speed002@umn.edu