TOP Final Evaluation Report
TeleHomeCare

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TeleHomeCare Description

The TeleHomeCare project is a collaboration between the University of Minnesota and 4 rural and urban home health care (HHC) agencies, and several technical industry partners. The rural HHC agencies are Tri-County Hospital located in Wadena MN, Lakewood Health System located in Staples, MN, and the HomeHealth Partnership located in both Crosby and Aitkin, MN. These agencies are all in north central Minnesota, approximately 250 miles from Minneapolis-St Paul. The urban HHC partner is Fairview Home Care, located in Minneapolis MN. Industry partners are CareFacts Information Systems Inc, St. Paul, MN, Onvoy Communications Inc, Minneapolis MN, and QRS Diagnostics Inc, Minneapolis, MN. The TeleHomeCare project combines actual and virtual HHC visits with the goal of delivering quality care at acceptable cost for patients receiving skilled nursing care at home. The TeleHomeCare project includes a randomized clinical trial to assess the effectiveness of video conferencing, Internet access, and physiological monitoring within a home health care setting. The overall objectives are to demonstrate that such a program can improve the quality and reduce or contain costs of skilled home health care, while increasing patient access to care and satisfaction with the home health care intervention. Outcome measures for this study are mortality and morbidity, need to transfer to a higher level of care (e.g. hospitalization or long term care facility), patient and caregiver satisfaction, patient utilization of services, and cost. The original project plan focused on patients with either congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), or chronic wound healing (CWH) who receive skilled nursing care at home. Due to reimbursement policy changes for home health care resulting from the Balanced Budget Act and the implementation of a Prospective Payment System for home health care, there was a shift in the numbers of eligible patients in the above disease groups, as well as increased difficulty in overall subject recruiting. As a result, THC Project recruiting focused on CHF and COPD, although some wound care subjects were recruited and have been included in the evaluation.

Eligibility requirements for participation in the THC Project were eligibility to receive skilled home nursing care for the above conditions, physical and cognitive ability of the patient or a supportive care partner to use the equipment within a technically functional home environment, i.e. one with sufficient space for the equipment to be set up and remain in one place, telephone and television, close proximity of telephone line to television, adequate lighting, and manageable clutter. The original project plan required all prospective subjects to be starting their acute skilled nursing home health care

immediately after hospital discharge. Due to recruitment problems we also considered patients receiving maintenance level (a reduced number of home visits each month) skilled nursing home health care to be eligible to participate. The THC Project was described to eligible patients by their HHC nurse and a short video was shown to them. Eligible acute patients agreeing to participate were randomly assigned to one of three groups within each partner HHC agency, stratified by medical problem. Eligible maintenance patients were also randomly assigned to the same three groups within each partner agency, stratified by medical problem. The control group (C) received standard home health care as determined by their underlying condition. There are two study groups for the CHF and COPD patients. One study group receives standard home health care supplemented with videoconferencing and Internet access (V). A second study group receives standard home health care, supplemented with videoconferencing, Internet access, and physiological monitoring (M). Subjects in M received pulse oximeters (for oxygen saturation), electronic spirometers (for pulmonary function), and blood pressure cuffs, depending on their underlying condition. Participation in the THC Project ended when subjects were discharged from HHC and either returned to their own homes or those of a relative, moved to a nursing home, were hospitalized, or died. All subjects provided informed written consent.

The project was implemented in four phases: focus groups, pilot study, full randomized clinical trial, and a transition phase. Focus groups were used to determine the reaction of potential users of home health care to the introduction of virtual visit technology into their homes and daily activities. A pilot study was then conducted to determine the feasibility of recruiting subjects, training nurses and patients, installing equipment in subject homes, and conducting virtual visits with a full complement of equipment. The full study provided the data for evaluating outcomes. The transition phase allowed each partner HHC agency to explore different approaches to implementing the THC program within their business plans.

There were 64 participants in 9 focus groups set up to obtain the reaction of potential users to the new technology. Participants ranged in age from 45 –86 years old. Each focus group session was 45-60 minutes, and consisted of a program presentation, videotaped simulation of a virtual visit, and discussion. The overall response was enthusiastic. Perceived benefits were convenience, less travel, and increased access to the care team. Concerns involved cost, space within an apartment, training, availability of equipment and HHC caregivers, trade-off with actual visits, and scheduling virtual visits. These concerns were addressed in designing the pilot study and in developing recruiting, training, and monitoring material for the full study implementation.

The pilot study involved 24 HHC patients. Each patient received all equipment, which was equivalent to the study groups using videoconferencing, Internet access, and physiological home monitoring. TeleHomeCare was successful with 13 subjects, and did not work with 11 subjects. The study was not acceptable in these 11 cases for a variety of reasons (severe illness; physical condition of the home was not compatible with study requirements-lack of space, cleanliness, clutter, no telephone; lack of interest; concerns about equipment use). In the successful cases, there were an average of 5.9 actual visits

and 6.7 virtual visits/subject. Average TeleHomeCare episodes were 35 days, and average time for each virtual visit was 25 minutes.

In the transition phase, various combinations of video/monitoring equipment were placed in 19 subjects homes. Subject health problems included diabetes, hypertension, atrial fibrillation, asthma, and anxiety. One partner HHC agency has purchased next generation videoconferencing equipment for their continuation of a telehomecare program. Another partner has developed their business plan for telehomecare and is investigating current videoconferencing and physiological monitoring hardware to be used in their implementation of telehomecare.

TeleHomeCare Evaluation

Subjects. In the full THC randomized clinical trial, 68 eligible patients agreed to participate in the study, and were randomized into control (C), video (V), and monitoring (M) groups. Of the 53 subjects who completed the study there were 19 C, 14 V, and 20 M in the three study groups. For several of the statistical analyses, the two intervention groups (C and M) were combined into a single study group of 34 subjects (VM). The remaining 15 subjects did not complete the study for a variety of reasons (moved out of state (1), telephone service or switching problems in their homes/senior apartments (2), discharged from home care or hospitalized before equipment could be installed or subject trained (3), immediate change of mind regarding willingness to participate (4), equipment problems (2) or concerns (1), didn't want to change HC nurses (1), and elected to participate in another study through primary care provider (1)).

26 (9 C, 8 V, 9 M) subjects were female and 27 (10 C, 6 V, 11 M) were male. Average age (and SD) for each group was 72.0 yrs (11.4 yrs SD) for C, 80.0 yrs (7.2 yrs SD) for V, and 72.9 yrs (9.8 yrs SD) for M. There were no statistically significant differences in gender or age between the C and VM groups. Diagnoses between groups were similar: 9 C, 7 V, and 8 M had diagnosis of CHF; 7 C, 7 V, and 11 M had diagnosis of COPD; and 3 C, 1 M had a wound care diagnosis. Most M group subjects used the monitoring and symptom reporting applications with little difficulty after receiving training from their HHC nurse. Training was done incrementally so as not to overwhelm subjects already often facing new home care procedures. After installation of equipment and a general review of telehomecare, the use of the videoconferencing equipment was taught during the next actual visit, and the use of the monitoring equipment (for the M group subjects) was taught in a third home visit. Seven of the 11 COPD subjects in the monitoring group used the spirometer to measure their lung function. They averaged 11.4 reports/subject (range of 4-19). Eighteen of the 19 COPD/CHF subjects in M used the pulse oximeter to measure their oxygen saturation; they averaged 31 reports/subject (range of 2-109).

Number of Visits (Actual vs. Virtual). Analysis of variance was used to test for differences between groups for continuous variables; chi-square analysis was used for categorical variables. There were no significant differences in the average number of actual visits between groups (23.5 for C, 16.5 for V, 19 for M, and 18.0 for VM). There were 2 subjects (1 in C, 1 in M) that had 96 actual visits each; excluding these 2 subjects still resulted in no differences between groups (19.4 in C, 16.5 in V, 15.0 in M, 15.6 in

VM). There were a total of 1057 actual visits for all 53 subjects. There were a total of 569 virtual visits for the 34 subjects in the VM group (average of 16.7 virtual visits/subject); of these, 277 were in V and 292 were in M. There were no statistically significant differences in average length of stay (in days) or in the natural log transformation of length of stay (in days) in home care between groups (124 days in C, 141 days in V, 141 days in M, and 141 days in VM). The visit intensity (number of actual visits/length of stay) was also analyzed to provide insight regarding the use of virtual visits to supplement, but not replace, actual visits. After excluding one subject (in C) who was seen at home at least daily for 9 days before being readmitted to the hospital (visit intensity = 1.11) there were no significant differences in visit intensity between groups (0.26 for C, 0.19 for V, 0.19 for M). We also looked at visit intensity across all subjects to determine if the implementation of the Prospective Payment System impacted actual skilled nursing home care visits. Again excluding the one visit intensity outlier subject, there were 18 for whom HHC ended before PPS, 22 for whom HHC started after PPS, and 12 for whom PPS started during their HHC episode. Regression analysis was conducted to control for whether the subject was acute versus maintenance in their phase of home healthcare, and in the experimental versus control group. This analysis showed that, as expected, acute patients have higher visit intensity (beta weight = .327, $p = .014$), controlling for PPS and experimental vs. control status. The beta weight for the experimental group was -.233 (a negative direction points to a substitution effect of virtual visits for actual visits), although its significance level was .084. The beta weight was .212 for subjects whose care was completed in the pre-PPS phase, although again the significance level was .107. Thus, there were no statistically significant differences in visit intensity pre to post PPS, and no substitution of virtual visits for actual visits in this study. However, it is possible that a larger sample would have provided more power to test for differences in visit intensity because of either of these issues.

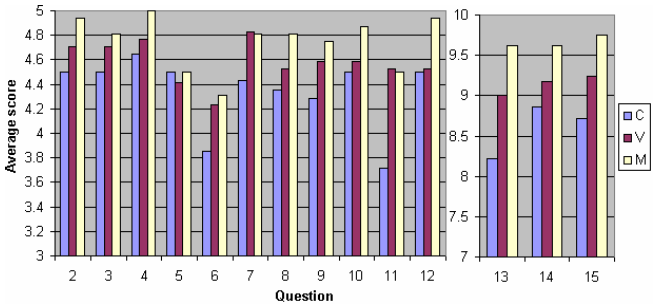
Morbidity - Discharge Destination; Mortality. All subjects were followed throughout their HHC episode and for 6 months after discharge from HHC to track their need for higher levels of care. They either returned to their home or to a relative, or were admitted to a higher level of care facility (hospital or nursing home), or were deceased. Because of relatively small numbers that would result in each of the 12 cells if the analysis looked at 3 groups (C,V,M) and 4 discharge destinations (hospital, nursing home, relative, self-care), the data was collapsed into 2 groups (C,VM) and 2 discharge destinations (relative/self, hospital/nursing home). Of the 19 C subjects, 8 entered a higher level of care (42%); 6 of the 34 VM subjects entered a higher level of care (17.6%), which included 3 of 14 subjects in V (21.4%) and 3 of 20 subjects in M (15%). A Fisher exact test was used to determine the difference between control and experimental groups for discharge destination and mortality. The difference in discharge locations between C and VM was on the border of statistical significance ($p=0.053$). Despite this difference in discharge destination between groups, there was no statistically significant difference in mortality (5 of 19 in C, 26.3%; 7 of 34 in VM, 20.6%).

Morbidity – KBS. Homecare nurses used the Omaha Problem List and rating scales to assess knowledge, behavior, and status (KBS) at admission to and discharge from home care. Problems assessed included Coping Skills, Activities of Daily Living (ADLs), Diet

Compliance, Medication Compliance, Circulation Deficit (CHF) and Respiratory Deficit (COPD). Separate regressions analyses were run for each problem's knowledge, behavior, and status. The dependent variable in these analyses was the discharge score (range from 1-5). The independent variables included the baseline score (range 1-5), the subject's length of stay in homecare, and dummy codes for whether the patient was in the V or M group. There were no statistically significant differences in KBS scores between the groups (C,V,M) with one exception. The ADL status score showed that, controlling for baseline status and length of stay, persons in the M group have a score that is .370 higher for ADL status than the control group ($p = .016$). The intercept for the control group is a score of 3.566. The V group also showed a higher beta weight at .261, although not statistically significant at the .05 level ($p = .081$).

Subject Satisfaction. There were two instruments used to assess subject satisfaction with the telehomecare project. The Home Care Client Satisfaction Instrument (HCCSI) was developed to evaluate satisfaction with general home care programs. It has been tested for validity and reliability. The TeleMedicine Perception Questionnaire (TMPQ) was developed for TeleHomeCare project to assess how subject perception of telemedicine changes with actual exposure to a telemedicine application. It has also been tested for validity and reliability.

Subjects completed the Home Care Client Satisfaction Instrument when they completed their participation in the study. [1] Subjects were called at home by a project staff member (the same person did all calls) and completed the form over the telephone. Forty seven subjects were successfully interviewed (14 C, 17 V, 16 M). The other 6 subjects could not be reached to complete the HCCSI. The HCCSI is a unidimensional instrument that includes 12 items rated on a 5 point Likert scale measuring specific aspects of home care, from very dissatisfied (score of 1) to very satisfied (score of 5). There are an additional 3 global measures of satisfaction measured on a 10 point scale. The items asked about level of satisfaction with: (1) helpfulness of office staff (omitted from bar graph below), (2) agency staff attention to concerns, (3) dependability of staff, (4) respect shown by staff, (5) staff knowledge of health problems, (6) having choices about care, (7) feeling safe when care was provided, (8) know who to contact with problems, (9) ability of agency to meet needs, (10) response to concerns, (11) scheduling of care, and (12) consistency in staffing. The 3 global items involved satisfaction with (13) agency ability to meet expectations for care, (14) overall care, and (15) recommendation of the agency to others.



Subjects in all groups were satisfied with their home care; those in the intervention groups showed equal or higher levels of satisfaction than the control group. T-tests compared the responses between groups. The increased level of satisfaction in M compared to C was statistically significant for both the basic items (items 2-12, p=0.02) and the global items (items 13-15, p=0.03). Greatest satisfaction increases were for questions dealing with “choices about care,” "feeling safe", "knowing contact person", and "flexibility in scheduling", with satisfaction increasing with increased level of intervention (C to V to M)

Forty six subjects (14 C, 32 VM) completed the TMPQ at entry into the study and after 30 days in the study. [2,3] Seven subjects did not complete the post-testing and are not included in the TMPQ analysis. The TMPQ includes 17 items using a 5 point Likert scale (strongly agree, agree, disagree, strongly disagree, no opinion). The higher the total score the more positive is the subject’s perception of telehomecare. The items address the effect of telehomecare on health care quality and accessibility, time savings for the patient and/or nurse, reduction of cost for the patient and/or the health care agencies, equipment use, acceptability of virtual visits compared to actual visits, privacy and confidentiality, lack of physical contact, and patient’s ability to explain medical problems during a virtual visit. Paired t-tests compared total scores and individual item scores within the groups for pre- and post-tests. An unpaired t-test compared changes of perception between the groups. There was no difference in pre-test scores for the two groups (mean total score was 58.14 (SD=5.08) and 58.03 (SD=5.12) for C and VM, respectively). The mean post-test scores were 58.1 (SD=5.20) and 64.80 (SD=5.0) for the C and VM groups, respectively. There was no difference between pre- and post- test total scores or for individual TMPQ items for C. The difference between pre- and post-test scores for VM were statistically significant (p=0.0001). Several individual TMPQ items also showed significant differences between pre- and post-testing for the VM group. These included an increased perception that the nurse can get a good understanding of the medical problem in a virtual visit, that virtual visits can save time for the nurse, that the telehomecare equipment is easy to use and is reliable, and that telehomecare does not violate one’s privacy. Perception decreased in the area of saving patient time and making it easier to contact the nurse. These results indicate that experience with telehomecare leads to a generally positive change in the patient’s perception of this technology.

Provider Satisfaction. Caregiver (homecare nurses performing virtual visits) satisfaction was determined using technical and clinical quality rating forms developed for this study. [4] Forms completed by 10 nurses evaluating 122 virtual visits with 10 different subjects in VM (6 CHF, 3 COPD, 1 Wound care diagnoses) were analyzed. In addition to subject and nurse identification, the forms included start and stop times for each virtual visit, a section containing 5 items regarding the technical quality of the virtual visit (frequency of audio and video problems experienced at the central agency site and at the subject’s home, respectively, and frequency of connectivity problems), and a section containing 3 clinically related items (would the visit have been better conducted in person, were there questions not asked during the virtual visit that would have been asked in an actual visit, and did the subject seem worried or concerned at the beginning of the virtual visit). There were 2 summary questions regarding overall rating of the technical quality of the virtual

visit and overall rating of the virtual visit for caring for the subject. The technical quality problem frequency was rated as either no problem or yes, and if yes, as occurring once, 2-3 times, more than 3 times, or caused the visit to be terminated. The average duration of the 122 virtual visits was 20.5 minutes (SD=8 minutes). In 64% of cases, the virtual visits had perfect technical quality. Either video or audio problems occurred in 7% and 6% of visits, respectively, and both video and audio problems occurred in another 16% of visits. A loss of connectivity during a virtual visit occurred in 7% of visits. In 92% of cases the connection for the virtual visit was established without any difficulty. Overall, the nurses' rating of the technical quality of the virtual visits as acceptable to excellent was 94%. This overall technical quality rating was highly correlated with the sum of the individual quality questions ($r=0.97$, $p<0.01$). An independent reviewer also viewed the videotapes of these 122 virtual visits to evaluate the reliability of the technical quality reporting forms. The individual technical quality ratings for each of the 10 nurses and the independent reviewer were all highly correlated ($r>0.89$ for each), as was the overall technical ratings of the nurses and the independent reviewer. Nurses reported that in 92% of cases the visit would not have been significantly better had it been performed with an actual home visit, and in only 5% of visits there were questions not asked because the visit was being conducted as a virtual visit. Subjects did not appear worried or concerned at the beginning of 97% of the virtual visits. They rated 77% of visits useful/very useful, 21% neutral, and 2% not useful for taking care of their patients.

Virtual Visit Content Analysis. All virtual visits were videotaped for both teaching and reliability purposes. A convenience sample of 30 virtual visits tapes covering all project sites and subjects in all disease groups were reviewed by one investigator. The basic unit of observation was any utterance (a sentence or clause) made by any of the persons involved in the virtual visit (e.g. nurse, subject, relative). An initial thematic code was identified from observations of videotapes from the pilot study and studies reported in the literature. These themes were refined into nine basic groupings while viewing the sampled tapes. A second evaluator reviewed a random sample of ten virtual visits to evaluate inter-rater reliability in coding decisions, using Cohen's kappa to evaluate degree of agreement. The nine basic themes identified for all virtual visits and the percentage of total visit time spent on each thematic area were assessment of subject's clinical status (42%), promoting compliance (taking medications, exercise, monitoring)(13%), psychosocial issues (10%), general informal talk (9%), education (8%), technical issues related to the telemedicine equipment (6%), scheduling visits (6%), ensuring accessibility (who to call with questions or in emergency) (3%), and assessing subject satisfaction with the virtual visit (3%). Content results were comparable to similar reports in the literature for actual home health care visits. The nurse spoke for 59% of the time of the virtual visits, and made the majority of the utterances (67%). The inter-rater reliability for the coding of the utterances was high; Cohen's kappa for agreement between reviewers was 0.87.

Cost Analysis. A cost analysis of actual visits (home health care nurses visit subjects at home) versus virtual visits (home health care nurses visit subjects using videoconferencing) was conducted. The average cost of actual visits was based upon the mileage traveled to each patient's home, the time spent in traveling, and the time of the

visit itself. The cost attributed to travel consisted of the IRS approved mileage reimbursement multiplied by the number of miles traveled, plus the average nurse hourly compensation (salary and fringe benefits) for all the participating home care agencies multiplied by the total travel time. To this was added the cost of the actual visit based on nurse compensation and visit time, plus an additional amount for administrative overhead. These calculations yielded an average visit cost of $44.71 for all actual visits conducted during the study. Calculations conducted to determine the average virtual visit cost were somewhat more complex. Sources of cost were nursing personnel time, amortized equipment costs, technical support costs and administrative overhead. The cost of nursing personnel time was calculated in the same manner based upon the amount of time reported for virtual visits. Equipment costs were based upon the acquisition cost of the ViaTV units for patient homes and ViaTV units, TV monitors, computers, telephone headsets and videocassette recorders for agency offices. These equipment costs were amortized over the potential number of virtual visits that could be conducted with the available equipment at the study rate of two per week for the period of the study – 2.5 years. The same approach to amortizing costs was applied to the monitoring equipment including blood pressure cuffs, scales, pulse oximeters and spirometers. Where equipment was donated, the retail price of the equipment was used. Technical support costs for patient in-home installations were determined by multiplying the total number of hours of technical support provided to patients times the average hourly wage including benefits divided by the total number of technical visits. Virtual visits were divided into three categories depending on whether they had only a videophone (the V group) or were being monitored (the M group) for CHF or COPD. The average video only virtual visit cost $22.96, the average CHF monitoring virtual visit cost $27.57 and the average COPD virtual visit cost was $31.74. The actual visit cost exceeded the cost of any of the types of virtual visits. The cost difference can be attributed primarily to the amount of additional nursing time related to an actual visit.

Utilization of services. Services utilized by HHC patients included home health care aides, physical and occupational therapists, and visits to hospital emergency departments, urgent care clinics, and local physicians. Data collection methods for this outcome measure proved to be inadequate because services were provided by a large and varied group of providers over varying time periods. Subject self-reporting would likely have been more effective than having the HHC nurses do a retrospective review of subject HHC charts, as originally planned and implemented. There was data collected for 13 subjects, but this was not sufficient for statistical testing. In this small sample there was a total of 56 physician visits (16 visits total for 3 C subjects, 5 visits total for 1 V subject, and 35 visits total for 6 M subjects but 19 visits total for 5 M subjects if exclude one M subject with 16 visits). There was a total of 10 urgent care visits (2 total visits for 2 C subjects, 1 visit for 1 V subject, and 7 total visits for 3 M subjects). There was a total of 5 emergency department visits (1 visit for 1 C subject, 0 visits for V subjects, and 4 total visits for 2 M subjects). There was a total of 10 other service visits (1 visit for 1 C subject, 1 visit for 1 V subject, and 8 total visits for 2 M subjects but 2 total visits for 2 M subjects if exclude 1 M subject with 6 visits). Based on this small sample it appears that subjects in all groups had similar levels of utilization of services.

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