Abstract: Although chronic disease now accounts for 70% of health expenditure, health systems have been slow in changing their focus from managing acute disease (infections and injury) to managing chronic disease, which by its nature is home or community based, requires continuity of care and must be managed by the patient in partnership with a multidisciplinary care team. We present a home telecare system for the management of chronic disease as an example of the use of integrated information technology for chronic disease self-management. We also report briefly on the outcomes of a clinical trial of CHF and COPD patients located in Sydney and Wagga Wagga, which demonstrated a high level of user compliance and satisfaction.

From our own studies and evidence in the literature we can conclude that home telecare supported by multidisciplinary care teams, can promote the development of partnerships between the patient and the care giver, facilitate patient self management, improve compliance and medications management and reduce the readmission rate for patients with chronic disease.

Managing CHF
There is a gap between research evidence and clinical practice and it has been proposed that individualised Patient Care Pathways are required to improve the management of CHF. [10] Management of patients is often poor as health delivery system has little experience in the management of patients with complex and chronic conditions. Patients may not be receiving correct drug therapy and doses are often sub optimal. Adherence to medications is poor. Patient self management is poor and specialised consultations lead to better outcomes.

CHF Survival
While overall mortality is high, the prognosis is not uniform across all patients. CHF is a progressive illness and the outlook for a given patient varies based on disease severity. It would appear that if the progression of the disease can be slowed or reversed, survival can be positively impacted.

Home care for CHF
Home care is becoming an increasingly viable and important way of providing monitoring and follow-up care to CHF patients. Intensive monitoring in the home has been found to decrease the incidence of hospitalisation and increase the functional capacity of elderly CHF patients [5]. Even low intensity home monitoring has been found to have a marked impact on the number of hospital admissions and the associated medical costs [6].

As an example of the impact of CHF on the state of NSW in Australia consider the following demographics:
- 23,000 patients are admitted each year with a primary diagnosis of CHF
- These patients account for 58,000 admissions
- Cost of each admission is on average $7,882
- 4000 CHF patients are admitted to hospital four or more times a year

Reports in the literature of outcomes of clinical trials designed to demonstrate the cost effectiveness of home telecare are very limited. Roglieri et al [7] found an 83% decrease in admission rate for those with pure CHF diagnosis (P= 0.008) over 1 year in the third quarter, 100% reduction for the 30-day readmission and an 83% decline in the 90-day readmission rates (P = 0.06). These results were corroborated by Jerant et al [8] in 2001 who reported that mean CHF-related readmission charges were 86% lower in the telecare group ($US5,850) than in the usual care group ($US44,479) and had significantly fewer CHF related Emergency Department visits (P= 0.034) and charges (P= 0.0487).
Materials and Methods

The home telecare system (HTS) was developed at the Biomedical Systems Laboratory of the Centre for Health Informatics (CHI) at the University of NSW over more than five years. A clinical trial in 2001-2002 funded by the Commonwealth Department of Health and Ageing [11] demonstrated that the system was acceptable and useable by patients and clinicians alike, and provided high quality data from the home. The HTS is scheduled to provide reminders for taking medications, for the collection of clinical signs and the delivery of health status questionnaires. Patients however can use the system whenever they wish. Data is automatically synchronised with a secure data server at CHI (using a standard modem over the telephone), processed and graphed and then becomes immediately available for viewing by any authorised member of the clinical care team from any location, using a simple browser. User interfaces are optimised and have been designed for use by even the frail elderly. All patient data records are de-identified and encrypted prior to transmission. Authorised members of the clinical care team can control all schedules, modify medication doses, view original data (ie ecgs, BP records etc), edit the automated results (ie systolic and diastolic pressures) add or delete recommended URLs for health education and change or select alternative health status questionnaires.

A patient record which summarises all clinical data collected over the previous three weeks can be produced on a weekly basis and sent to the patients’ GP by e-mail, fax or by mail. Patients can view their own data by selecting “MY RESULTS” on their home telecare system as shown in Figure 2.

The Home Telecare system consists of a home clinical workstation, a wearable ambulatory monitoring unit, a home personal computer (PC), a 56kb modem and access to the Internet. The home PC interface was specifically designed for ease of use, even by elderly and frail patients. A sophisticated yet easy to use graphical user interface was developed whereby all functions are accessed via large easy to see graphical icons on the screen. The patient’s doctor can fully control the scheduling of all recordings and can manage medications remotely over the internet. The patient is scheduled to periodically use the home clinical workstation to measure important physiological parameters of weight, body temperature, blood pressure, lung function and ecg. Quality of life and functional health status are measured using standardised questionnaire tools delivered on the home PC and completed by the patient. Specialised questionnaire tools are used to ask routine clinical questions specifically relating to the disease condition. Patients maintain an electronic diary of all of their medical consultations. The wearable monitor is a wireless connected triaxial accelerometer which both monitors stumbles and falls and acts as an alarm system.

Key features

- Optimised for use over normal telephone lines, but fully network enabled for broadband
- Low cost - modular (pick and choose)
- Low tech – practical, but sophisticated ICT backbone
- Simplicity - intelligent user interfaces
- Clinically relevant – design driven by clinical need!
- Promotes high user compliance
- Generates an electronic health record (EHR) from the home
- Access to Web information services
Clinical Trial

This system was recently successfully trialled in late 2001 with a small population of 22 patients located in the Sydney area and in Wagga Wagga, a rural centre 400km southwest of Sydney. Patients were selected as having a primary diagnosis of Congestive Heart Failure (CHF) or Chronic Obstructive Pulmonary Disease (COPD) and having been hospitalised for that condition in the previous year. All patients recruited were able to successfully use the home telecare system and data was collected in every case for at least six months. After a period of six months the final questionnaires were administered to both patients and clinicians and the results analysed.

Results

Patient Statistics: From the sample population, 13 patients had COPD as their only complaint, 5 had CHF as their only complaint while 4 patients had a diagnosis of both CHF and COPD. There was a preponderance of males participating in the trial by 14:8. The mean age of the participants was 71 years old with the oldest participant being 82 years old and the youngest 61. Most patients were compliant with their recommended program of measurements. For the 17 patients that suffered from COPD or both COPD and CHF, the patients were mainly distributed in the upper half of severity of lung disease. In the case of the five patients who were diagnosed exclusively with CHF the patients’ severity of illness varied from no symptoms to being bed–ridden as a result of their heart failure.

Patient Responses: Subjects were asked to complete a questionnaire before and after the study to gauge their views on the home telecare system. Some representative responses include;

- All patients (100%) found the home telecare system easy to use
- 95.4% of patients (all but one) were satisfied with the home telecare system
- 95.4% of patients used the home telecare system at least once a day
- 95.4% of patients wanted to continue using the home telecare system on a regular basis

The trial was continued for a substantial period beyond the scheduled end date as it was found difficult to withdraw use of the Home Telecare System from the participants. The level of compliance was almost 100% over the duration of the trial indicating that all patients found the system extremely useful in the management of their condition. As a result patients were most reluctant to give up the equipment as they had all observed substantial benefit either from a stabilisation of their condition or in some cases a reduction in the number and severity of their admission to hospital.

One example of early detection of a severe and potentially life threatening exacerbation of a chronic disease condition, and a reduction in the length of stay in hospital is reported in [9].
**GP Evaluation:** Overall, 88.9% stated that they were either very satisfied or satisfied with the system. 11.1% were neutral. No one expressed dissatisfaction with the system. 88.9% of the GPs felt that the home telecare system could play an important role in the management of their patients’ health, and 11.1% were not sure. 66.7% stated that they would like to continue to use the home telecare system on a regular basis, whilst the remainder was undecided.

**Conclusions**

A comprehensive home telecare system has been developed and trialled on a representative population of patients suffering from CHF and COPD. The useability, functionality and effectiveness of the system was demonstrated from both patient, clinician and operational aspects, successfully bringing formal standards of care to informal care settings in the home.

There was generally a high level of acceptance of the home telecare system with both patients and their general practitioners responding favourably on its ease of use, effectiveness and likely impact on improving management of the patients’ chronic disease at home.

Although a detailed evaluation of health care outcomes and cost benefits of the clinical trial was beyond the scope of this project, numerous case studies were identified where the availability of a home telecare longitudinal patient record was able to either prevent hospitalisation or reduce the length of stay.

**References**

(Journals)


(Electronic Publications)
