The impact of remote patient monitoring in managing silent myocardial infarction in a residential home setting

Malcolm Clarke, Tanja Bratan, Sadhana Kulkarni, Russell Jones**

Brunel University, London
*Chorleywood Health Centre, Chorleywood, UK

ABSTRACT

Objective: We describe the impact of a remote patient monitoring (RPM) system implemented in residential care homes.

Methods: The service was designed to support the staff in managing patients that presented with non-specific symptoms. The system allows vital signs to be transmitted to a central server. The medical professional may then observe the data and provide advice to the staff on optimum management. Our system has been evaluated for 18 months and largely provided routine measurements.

Results: During this period, three residents presented with non specific symptoms that were investigated using the RPM system. One patient had symptoms over a weekend, and the problem remained unresolved on Monday. The resident continued to only complain of feeling unwell, but reported no specific symptoms. Vital signs data were then sent and the doctor consulted. The electrocardiogram (ECG) showed significant ST segment changes. Repetitive measurements of the ECG, heart rate, and oxygen saturation of the blood (SpO2) were made every 5 minutes. The resident had a history angina and CHF. The staff were asked to give the patient aspirin and anti-angina drug. The ECG was seen to resolve after 40 minutes, but the SpO2 was falling. The decision to send to hospital was taken at this point. Two further patients with significant ECG changes were observed during the period of the project, and again both were asymptomatic, but in these cases the condition resolved and hospital admission was avoided. Feedback from users has been very positive. Staff found that the system gave them support to make better informed decisions on patient management, especially when determining whether to admit the person to hospital when reaching end of life. Further comments were that the system also proved useful to reassure relatives during these final stages.

Conclusion: Our project demonstrated that significant cardiac events occur in the elderly population of residential homes without symptoms; and that RPM can be used by non medical staff to manage asymptomatic patients in the community.

(Anadolu Kardiyol Derg 2007: 7 Suppl 1; 186-8)

Key words: remote patient monitoring, telemedicine, telehealth

Introduction

The problem of the aging population and its likely impact on the provision on health care systems throughout the world is well documented (1). However an older population will not only have an increased prevalence of chronic disease that will have to be managed efficiently and effectively, but also tend to succumb to acute illness quickly, reaching critical condition rapidly. If health systems are to manage an increasing level and complexity of disease, novel methods need to be developed. Technology is seen to offer a solution, particularly if it results in methods to manage patients in the community and keep them out of expensive hospitals (2). Primary care is seen as offering much towards the solution: the patient can be kept in their own home, thus avoiding the hotel costs of hospital; the patient's own care-givers can provide no-cost nursing; and the actual costs of primary care are often lower than the equivalent service provided from hospital. Furthermore, patients prefer to remain in a familiar environment when ill.

Methods

We have developed a system in which vital signs monitors are placed in a residential home (Fig. 1). A wireless network within the residential home allows monitoring to be undertaken at any location. ADSL broadband is used to transfer data through a secure link over the public internet to the data server. The local general practitioner (GP) and staff of the home may review the stored data on the server.

The purpose of the system was to intervene in the admission of residents to hospital when the staff of the home had concern with the resident's health. Although the local GP surgery would provide routine health care, on numerous occasions a resident would have a problem at a time when the GP was unable to visit and provide advice. This normally resulted in emergency admission to hospital.

Telemonitoring was introduced to modify the patient care pathway and was seen to provide triage (Fig. 2). Vital signs, including 7 - lead electrocardiogram (ECG), oxygen saturation of

Address for Correspondence: Dr Malcolm Clarke, Senior Lecturer in Data Communication Systems and Telemedicine
Department of Information Systems and Computing, Brunel University, Uxbridge, Middlesex, UB8 3PH, UK
Phone: +44 1895 265053 Fax: +44 1895 251686 E-mail: malcolm.clarke@brunel.ac.uk

the blood (SpO2), blood pressure and temperature, were transferred from the resident causing concern to the data server and the GP informed. Having viewed the data, advice on the management would be given.

Results

On the morning of Monday 8th November 2004, staff at the residential home requested a GP visit for one of their residents, who looked unwell, was hallucinating, and was experiencing breathing problems. The resident did not have a history of chest pain. It was not possible to schedule a GP visit until early afternoon. In the early afternoon, one of the nurses from the surgery associated with the home carried out a routine visit to a number of residents at the home. She was asked to also see the resident who was unwell, and observed that the resident clearly looked ill, with swollen legs, breathlessness and chest pain, which she only described as discomfort. At this point the telemonitor in the home was connected to the resident and ECG, heart rate, blood pressure, temperature and oxygen saturation measurements were taken and transmitted to the server. In order to verify correct positioning and working of the leads of the recently upgraded 7-lead ECG, the manager contacted the Technical Director of the research project via telephone. He observed that the ECG was clearly abnormal (Fig. 3) and immediately contacted the home's doctor at the surgery. The doctor viewed the data over the website and saw from leads III and aVR of the ECG reading that the patient was having an acute ischaemic attack and bradycardia. Furthermore the SpO2 was decreasing, and blood pressure and pulse were elevated which further indicated that a significant cardiac event was occurring.

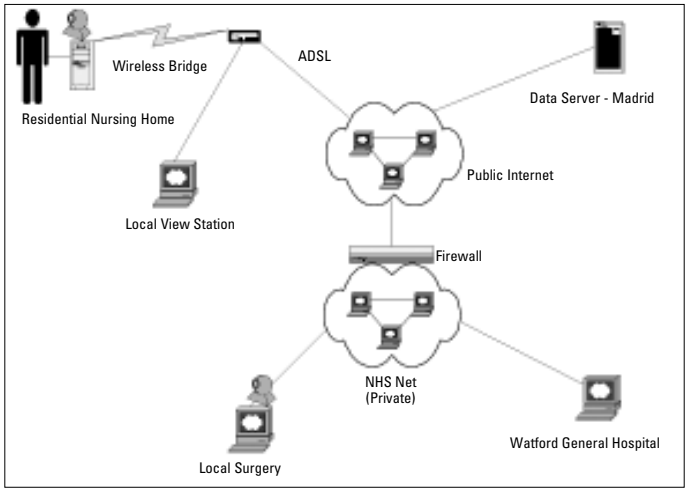

Figure 1. System architecture

The doctor then visited the home immediately, and on examination found the patient cyanosed, bradycardic and wheezy, and she diagnosed cardiac failure. The glyceryl trinitrate (GTN) treatment was given for angina and aspirin for anticoagulation. Following administration of GTN, the angina began to resolve, and further ECG recordings showed ST returning to normal level, although Q-wave inversion remained (Fig. 4). However, the SpO_2 continued to fall, the patient becoming increasingly breathless (top trace in Fig. 5). The home does not have oxygen on site, and so at this point an ambulance was called and the patient was admitted to hospital.

It is important to note that these residential homes are not normally equipped with an ECG recorder or an SpO_2 sensor, and ordinarily no ECG could have been taken. The vital signs measured, in particular the ECG recording and the SpO_2, enabled the nurse, the Technical Director and the doctor to realise quickly that the patient required urgent emergency cardiac treatment, which resulted in managed admission to hospital.

Discussion

Our results demonstrate that the non medical staff of a residential home may be supported to gain vital signs from residents and make them available for advice on management of a medical condition. In three incidents, staff were assisted in diagnosing cases of silent myocardial infarction that may otherwise have been unrecognised. Staff were advised on prompt response on treatment and the changing condition of the resident was able to be followed to support safe management. In one case, further deterioration was able to be monitored, resulting in managed admission to hospital. Our results further demonstrate that technology may be easily

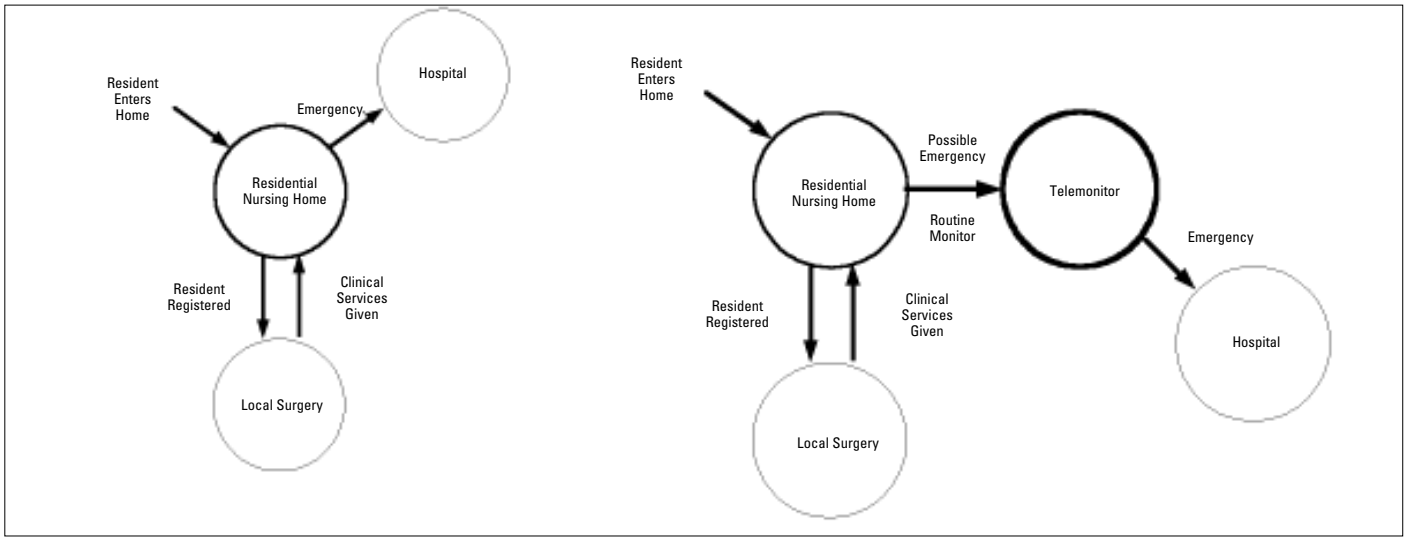

Figure 2. Patient care pathway

Anatol J Cardiol 2007: 7 Suppl 1; 186-8
Anadolu Kardiyol Derg 2007: 7 Özel Sayı 1; 186-8

installed into a residential setting and exploit readily available broadband services. Although the bandwidth from the residential home to the server is significantly less than in the opposite direction (a feature of ADSL) it proved sufficient for this application. Wireless networks were proven to support rapid deployment and allow monitoring in any location. The construction of the walls in some buildings did reduce wireless range in some cases to less than 20m and many access points were required to ensure full coverage. The skill of the GP could be an issue, as not all would have sufficient experience in cardiology to recognise conditions and their management. In response, the support of other doctors or cardiologists would need to be gained. As the system could allow access by others, then support from a "virtual team" could be provided.

Figure 3. ECG recording at start of incident at 14:15

ECG- electrocardiogram

Figure 4. ECG recording after GTN at 15:00

ECG- electrocardiogram, GTN- glyceryl trinitrate

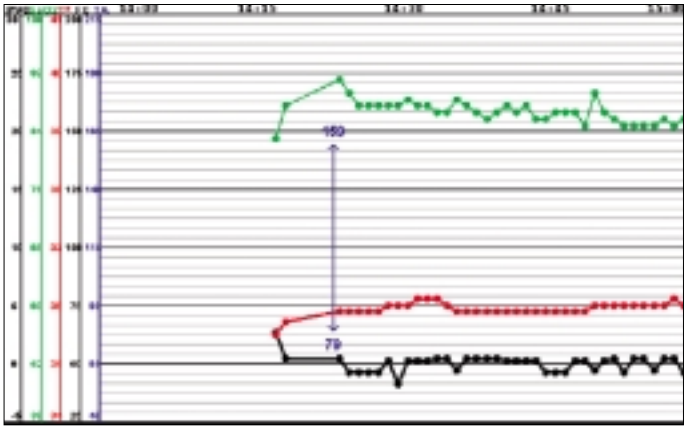

Figure 5. SpO_2 recording (upper trace)

SpO_2- oxygen saturation of the blood

References

1. WHO. Ageing and life course. Available at: URL: http://www.who.int/ageing/en/ (Accessed 28 December 2005)
2. Balas EA, Iakovidis I. Distance technologies for patient monitoring. Interview by Abi Berger. BMJ 1999: 319: 1309. Available at: URL: www.bmj.com.