A clinical perspective on remote monitoring of chronic disease

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Summary: Chronic disease management programmes have developed rapidly in an attempt to provide high quality evidence-based care to an increasing number of people living with chronic medical conditions. Such programmes are frequently based on regular home or clinic visits that limit their ability to match demand. Innovative methods to extend the reach of such programmes are urgently required. This article discusses the use of remote monitoring as part of chronic disease management and draws upon the authors’ experience in a heart failure population.

Key words: Technology, Remote Monitoring, Chronic Disease Management, Delivery of Care

The number of people living with chronic disease, particularly cardiovascular disease, is increasing rapidly across the world, largely due to the unprecedented ageing of the world’s population. This provides a major challenge to health care systems, particularly where access to optimal evidence-based care is poor. There is a need for innovative strategies to provide support for high quality chronic disease management. Telehealth has been proposed as one such strategy.

In theory, such technology should enable the limited number of health care professionals to interact with a larger number of individuals with chronic health problems. This facilitates the early identification of problems requiring health care intervention (such as hospital admissions, doctor office reviews, or change in medication), whilst empowering individuals to continue living in their own environment, with higher levels of self-care.

The remote monitoring of patients (telemonitoring) is challenging, not least because of the change in working practice for health care practitioners, but the evidence is accumulating that such an approach can be an effective component of high-quality care. There is a large degree of heterogeneity in the structure of telemonitoring programmes, and it remains unclear as how best to employ both technology and staff, and how to integrate new programmes into existing health care practice. The most robust evidence applies to diabetes, chronic lung disease and heart failure. In many health care communities, telemonitoring has been introduced without much consideration of how it should best be employed or how it fits into the usual information flow about patients. An early review of the technology concluded that although feasible, such technology had yet to prove its clinical benefit. Professional disease guidelines remain largely silent on how best to use this technology. This article reflects on the authors’ own experience in using telemonitoring for patients whose predominant medical problem is heart failure.

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Traditional models of chronic disease management

Chronic diseases are, almost without exception, characterised by acute exacerbations. It is during one of these acute events that the patient is likely to present either to their primary care physician feeling generally unwell or to the emergency department of the local hospital. The trajectory of chronic illness then becomes marked by increasingly shorter periods of stability between acute exacerbations. To assist in the early recognition of the often subtle signs and symptoms of deterioration regular follow-up with a health professional is encouraged. In primary care based health services (such as in the United Kingdom) this regular follow-up is provided by the general practitioner, with secondary care clinic visits only at six to twelve month intervals. The effectiveness of this model relies upon good communication between the patient, primary and secondary care, and the many other professionals involved (primary care physician and practice nurse, community pharmacist, and the hospital specialist medical consultant and nurse).

Multidisciplinary disease management programmes, frequently led by a specialist nurse in secondary care, have developed to optimise management of chronic conditions such as diabetes, chronic airways disease, or heart failure. Such programmes provide education to facilitate self-care (including monitoring), ensure appropriate up titration (dosage raising) of drug therapy, and facilitate collaboration within the multidisciplinary team. This approach is recommended in current international clinical guidelines.2-4

Many patients are elderly and their decreased mobility and lack of social support is likely to impact upon clinic attendance. Home-based models of care can circumvent this problem but are costly in terms of travelling time for the health care professional. This reduces the number of patients that can receive care. Telemonitoring offers the promise of enabling such professionals to extend the reach of disease management programmes, ensure more appropriate use of health care resources, and provide care at a time and place more convenient to the patient.

What is telemonitoring?

Telemonitoring (‘remote monitoring’) refers to patient monitoring where the patient and health care professional are separated by geographical distance. The information is transmitted from the patient (usually in their home) to the health professional. The transmission can be relayed in real time (synchronous), or asynchronously where the information is stored and forwarded for review later. In most cases, data are transmitted using the domestic telephone line, although within the home, data may be transmitted wirelessly from the monitoring device to a unit plugged into the telephone line.

The monitoring technology can vary in complexity from simple monitoring of such physiological data such as blood pressure, pulse, blood oxygen level, blood sugar or body weight, to implantable devices (such as heart pacemakers or defibrillators) whose functions can be monitored remotely, and in some cases also reprogrammed remotely. Very sophisticated implantable monitors that can measure the pressure within heart chambers or large blood vessels, or the amount of water in the lungs, can also be monitored remotely. This adds to the physiological data that can be provided to a health care practitioner to facilitate better management of the underlying heart condition.

Figure 1 shows an example of a commercially available external monitoring device that measures weight, blood pressure, oxygen saturation and also transmits the patient’s responses to a series of questions about changes in their symptoms.

Clinical benefits

Much of the early support for telemonitoring comes from observational studies, without appropriate comparator groups. Such studies are likely to underestimate the clinical effect of the technology, but do at least provide firm evidence that the commercially-available platforms are physically robust, relatively easy to install and operate, and largely acceptable to both patients and health care professionals. Most studies report more than 80% compliance of patients with telemonitoring, regardless of duration of monitoring or age. In our own experience in an elderly, multiethnic, metropolitan area, poor compliance with monitoring is rarely an issue, particularly with good family support.5

More recently more rigorously designed randomised studies have been undertaken. These are likely to be much more influential on the clinical community than the earlier observational studies. Paré and colleagues undertook a review of all high quality randomised trials of home telemonitoring in chronic illness undertaken before 2006.6 Identifying a total of sixty-five studies in a variety of chronic conditions (diabetes, hypertension, heart and lung disease) they were able to conclude that telemonitoring consistently provided the health professional with accurate data on which to plan care, but there were inconsistencies in its effect upon health care utilisation and overall patient outcome.

Turning to the literature specifically related to heart failure management, Clark and colleagues undertook a review where they combined the results of five randomised trials of telemonitoring using equipment external to the patient.7 The combined results suggested an impressive reduction in the risk of death of around 40% with telemonitoring compared with usual care, with the absolute risk of death being of the order of 20% in patients in the control arms of the studies, which followed up patients for three to fifteen months. In addition, they reported a trend towards a reduction in hospitalisation (for any cause) in patients who were telemonitored, although this result could have arisen by chance (P value >0.05). An important caveat to this overview is that the studies included tended to recruit relatively young and highly motivated patients with...
advanced disease and, importantly, with fewer coexisting illnesses (comorbidities). This makes it difficult to extrapolate the findings to the general population.

More recently, we reported on the Home-HF (Heart Failure) study in a general heart failure population of elderly patients (with a mean age of 71, 45% >75 years) where we compared six months of daily telemonitoring with specialist heart failure care.5 Whilst demonstrating no difference in hospitalisation (for any cause) we found strong evidence that emergency room visits, clinic reviews and unplanned hospitalisations for heart failure were reduced. This confirms the feasibility of detecting decompensation of chronic heart failure syndrome early and making health care interventions in a planned manner as a result of daily physiological data transmission to a specialist heart failure nurse. The outcome was similar to that provided by traditional specialist heart failure care, but the specialist nurse was able to monitor considerably more patients than was usual.

The patient perspective
Qualitative research provides interesting insights into patients’ perceptions of health care. Patients with chronic medical conditions (and their families) often feel overburdened with the responsibility of care and frustrated by the difficulty of navigating the health care system. Whilst they know the signs and symptoms to observe, they find it difficult to identify relatively subtle changes which may warn of an impending acute exacerbation. Consequently they delay seeking professional help.8,9 Telemonitoring may have an important role in supporting people to gain confidence in living with and managing chronic disease.

Our experience with patients using telemonitoring suggests the direct link between them and the health professional provides reassurance that any important change will be rapidly identified and management commenced promptly. Telemonitoring also increases patients’ understanding of how to manage their symptoms and results in many feeling more in control of their heart failure management. Patient satisfaction with this approach to care is high.

The changing geography of health care
Telemonitoring challenges traditional health care practice. Whilst it can be integrated into established primary or secondary care services, it may also develop out of relationships with new service providers such as “call centres”. Working across a plurality of providers is new within many health care systems, including those in the UK. To be effective, an integrated and coordinated strategy is required that works across different agencies and has clearly identified lines of communication and responsibility.

These changes bring perceived threats to traditional professional roles. The potential for a non-professional, protocol driven approach to the initial patient assessment and triage may restrict the identification of relevant nuances in the patient history. Telemonitoring also has the potential to increase patient contact with the specialist, possibly at the expense of contact with the primary care physician. In health care services such as those in the UK, where primary care acts as the first point of contact and is responsible for deciding when and whom to refer for specialist advice, this raises reimbursement issues that have yet to be resolved. Where telemonitoring centres operate outside of traditional professional health care services then commissioners need robust arrangements to ensure patient safety and the continued delivery of high quality care.

Conclusion
Telemonitoring offers much promise. It has been shown to be technically feasible and user friendly and is acceptable to patients with chronic disease. It significantly increases the number of patients that can be cared for and facilitates timely intervention to resolve health issues. When problems cannot be resolved remotely, it enables good use of health care resources through appropriate scheduling of outpatient clinic review, a home visit or even a hospital admission. However, it changes traditional working practices and requires the flexible organisation of health care. These challenges must be overcome if telemonitoring is to fit seamlessly into the landscape of health care.

References