Economic considerations of remote monitoring in chronic conditions

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Summary: Remote monitoring systems allow for the capture of routine information on the health status of individuals with chronic conditions. The potential benefits of remote monitoring include reduced demand on scarce health care resources and more intensive monitoring of an individual’s health, which may ultimately result in improved long-term outcomes. Evidence on the economic benefits of remote monitoring remains equivocal. Further research of the cost effectiveness of remote monitoring in practice is warranted.

Key words: Remote Monitoring, Telemedicine, Economics, Chronic Conditions
mously, to describe the application of modern information and communication technologies to health and social care. These broad definitions capture a range of technologies, from patient operated alarm systems often used in residential care, to technologies designed to allow for a virtual consultation with a health care professional, particularly in remote geographical areas, to technologies designed to allow health care professionals to monitor the health status and vital signs of individuals in real time.

Remote monitoring (sometimes referred to as telemonitoring) of chronic conditions is one of the most widely used applications of technology in health care. Remote monitoring involves capturing information on vital signs or clinical indicators to monitor a patient’s condition. Remote monitoring can take many forms. In some cases, patients may be required to manually input data into a device and then transfer the data, through a telephone or computer interface (often referred to as ‘store and forward’ systems). Data can then be stored on a secure server and accessed by a health care professional able to interpret the findings. More advanced technologies include automated data capture, often in real-time, and communication through the use of advanced information systems comprising wireless communication.

Such technologies have been widely used in investigative studies in common chronic conditions, including diabetes and heart disease. The rationale for adoption in chronic conditions appears to be based on several hypotheses:

- Firstly, remote monitoring can reduce the need for routine consultations with a health care professional by providing regular information on an individual’s health status;
- Secondly, by providing more regular or continuous information on vital signs, remote monitoring can allow for more intensive management of an individual’s condition which has the potential to reduce acute exacerbations and improve long-term outcomes;
- Thirdly, patients are expected to find remote monitoring more convenient and accessible than direct consultations with a health care professional.

In chronic conditions such as diabetes and heart disease, these benefits might manifest themselves in the form of tighter control of blood glucose levels or blood pressure and ultimately reductions in serious adverse outcomes, such as hypoglycaemic events or heart attacks. The potential benefits have both clinical and economic implications for patients and the health service. The challenge is to generate evidence to show that these theoretical benefits can be realised in practice.

The economic evidence on remote monitoring

There is a growing body of evidence on the clinical and cost effectiveness of telemedicine interventions, including remote monitoring technologies, in the management of chronic conditions. However, empirical analysis of the evidence on the cost effectiveness of telemedicine interventions has raised concerns about the quality of evidence available to support these technologies.

Roine and colleagues conducted a systematic review of the evidence on telemedicine interventions in 2001. The review included several studies of remote monitoring interventions, the majority of which were intended to contribute to the management of diabetes and heart disease by monitoring vital signs. Whilst the majority of these studies produced improvements in clinical indicators (for example, HbA1c levels, blood pressure), evidence to support an economic benefit of remote monitoring was limited. Where economic analyses were included in studies these tended to focus only on costs. Only one study was identified which reported cost effectiveness ratios for an intervention designed to assist in managing blood pressure.

Whitten and colleagues conducted a systematic review of cost effectiveness studies of telemedicine interventions, published in 2002. The review identified fifty-five studies of telemedicine that captured cost data. Over 50% concluded that telemedicine saves money/time and money whilst only 7% concluded that telemedicine does not save money. However, these positive findings need to be considered with some caution and the authors noted that the economic evidence tended to be derived from small-scale, short-term studies that were often characterised by poor design and inadequate technical quality. The majority of studies included only partial analysis of costs and no examples of full cost utility analysis were identified. The authors concluded that there was only limited persuasive economic evidence to support the routine adoption of telemedicine.

A further review paper published by Paré and colleagues in 2007 examined the evidence specifically related to home telemonitoring for four chronic conditions, namely diabetes, cardiovascular disease, pulmonary disease and hypertension. The review included a total of sixty-five empirical studies across the four disease areas. The authors reported that the research indicated that home telemonitoring was largely safe, efficacious and acceptable to patients. However, as per the earlier reviews, the authors noted the absence of an unequivocal economic case. Of the studies included, 26% included some form of cost analysis. The authors were unable to make any recommendations based on the findings of these studies, mainly due to limitations in the methodologies used and heterogeneity across the studies. The authors did though make a strong case for future studies of home monitoring to focus on examining issues associated with patient outcomes, quality of life and the economic implications for health services. This evidence is seen as being important to securing more widespread adoption and coverage by payer bodies.

Discussion

These reviews highlight the equivocal nature of the economic evidence on remote monitoring in chronic conditions. However, these findings need to be interpreted in context. Home monitoring remains a relatively novel health care intervention, having only been introduced into mainstream practice over the last two decades. As such, the evidence base remains in development and largely derived from small-scale pilot studies. The reviews considered above suggest that the volume of economic evidence on these technologies is increasing over time, although there is still some concern over the quality of studies, particularly with regard to their short-term nature and the widespread use of partial economic analysis.

It should be acknowledged that the evaluation of such technologies is challenging for a number of reasons. First, remote monitoring is a disruptive technology that requires changes to treatment pathways and the attitudes of health care professionals, all of which take time. For example, despite the more intensive nature of remote monitoring, health care profes-
sions may continue to adhere to their usual referral patterns for some time following its introduction. Care needs to be taken in designing studies of remote monitoring technology to ensure that the benefits are fully realised in trial settings.

Second, the evaluation of remote monitoring technologies is highly context specific. That is, the effectiveness of the technology is also heavily dependent on local treatment pathways, health care professional’s attitudes and patient populations. As a result, much of the research published to date has been characterised by poor external validity, meaning that more widespread adoption may be restricted due to the limited generalisability of study settings.

These factors suggest that more pragmatic, observational, in-use research on remote monitoring technologies is required. Such studies should take care to ensure that they are designed to allow for an assessment of the effectiveness of remote monitoring relative to current practice, and also capture the impacts of novel technologies on organisational and financial outcomes. Ideally, studies should incorporate full economic evaluations as opposed to the partial analyses that characterise the majority of evidence published to date. Frameworks for the evaluation of telemedicine have been made available.12

The absence of robust economic evidence on remote monitoring systems, and telemedicine interventions more generally, is a concern. However, it is worthwhile considering the primary intention of many remote monitoring systems. Such systems are often developed with non-financial objectives, including improving access to care, patient satisfaction and health outcomes. Whilst these systems have the potential to lead to more efficient use of health service resources, they will not necessarily lead to reductions in health care expenditure. Indeed, it has been suggested that whilst technology offers the potential to reduce the demand for less complex consultations it should be considered as an adjunct to direct consultations with a health care professional, rather than as a substitute.13 If this is the case then technologies such as remote monitoring may require increased investment in return for improvements in patient outcomes and access.

The absence of an unequivocal argument to support the cost effectiveness of remote technologies means that coverage and payment remain barriers to adoption in many countries. Whilst remote monitoring systems may offer potential efficiencies in the use of health care resources, it has long been acknowledged that reimbursement systems need to change to incorporate innovation.14 Indeed, many reimbursement systems, particularly those based on fee-for-service, actually disincentivise the use of telemedicine by providing coverage for direct consultations but not for remote monitoring. The result is an incentive to rely on unnecessary consultations, many of which could be managed more efficiently using technologies that permit remote monitoring.

There are signs of expanding reimbursement and coverage for remote consultations and monitoring, particularly in the United States.15 However, many routine monitoring technologies find themselves in something of a vicious circle. Payer bodies are reluctant to provide widespread access, as the evidence that is available for the technologies is derived from small scale studies which are criticised on the grounds of their limited applicability to a larger population. However, generating evidence in a larger population demands that such technologies are more widely available which requires some form of coverage and reimbursement to be in place.

Appropriate financial incentives for remote monitoring need to be put in place. These should ensure that the efficient use of remote monitoring, instead of direct consultations, is incentivised where this is clinically justified. Systems also need to be put in place to ensure that patient care is not compromised through any reduction in direct contacts with health care professionals. Finally, it is vital that information is captured prospectively on the use of these systems to determine whether they offer improvements in patient outcomes, access to care and health service efficiency. Only by generating further evidence can payer bodies make a rational decision about the appropriate use of remote monitoring technologies.

REFERENCES