

## REVIEW

# Technology and its role in respiratory care

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### Abstract

**Introduction:** Telemonitoring, telemedicine, clinical and medical informatics or telecare, are terms used to describe the use of technology along with local clinical protocols to monitor remotely a patient's medical condition in their own home. In respiratory medicine, where large numbers of people have long term conditions such as asthma and chronic obstructive pulmonary disease (COPD), the role of such monitoring technology in the management of patients is of great interest.

**Aim:** This review seeks to explore what evidence exists to support the deployment of technology to improve the care of people with respiratory conditions.

**Method:** Narrative review .

**Result:** A wide variety of technologies have been involved in asthma and COPD care, from management systems to self monitoring devices. Many studies report that staff and patients 'liked' the technology. The service, care and financial benefits to both patients and the health care system were less obvious. Many studies suffered from poor methodology and lacked clear endpoints.

**Conclusion:** There is an enormous potential for telemonitoring to assist in the provision of better care for those with long term lung diseases. However, evidence of benefit is unclear and there remains a need for robust studies and answers to clear research questions for specific patient populations before such technologies can be recommended for widespread implementation.

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**Keywords** informatics, telemedicine, telemonitoring, telecare, telehealth, e-health, COPD, asthma

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### Introduction

Telemonitoring, telemedicine, clinical and medical informatics, or telecare, are terms used to describe the use of technology along with local clinical protocols to monitor

remotely a patient's medical condition in their own home. The focus upon such health technology and its swift deployment within the UK National Health Service (NHS) through the commissioning of 'demonstration sites' and health service improvement projects<sup>1,2</sup> highlights the interest in, and the rapid development of, a variety of health care technologies.

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These technologies can take any number of forms such as web-based applications,<sup>3</sup> mobile phone and alert systems,<sup>4,5</sup> telephone and video conferencing with patients,<sup>6,7</sup> as well as any combination of these applications. In the last five years there has been a rapid increase in the use of monitoring technology as a management tool for long-term conditions despite a lack of robust evidence of clinical benefit to patients.<sup>8</sup> Telemedicine as a method of providing healthcare to remote areas is not lacking in evidence of benefit, especially for consultations saved, journeys avoided and diagnoses changed,<sup>9</sup> but the situation regarding its more general use for monitoring purposes is much less clear.

In respiratory medicine, where large numbers of people have long term conditions such as asthma and chronic obstructive pulmonary disease (COPD), the role of such monitoring technology in the management of patients is of great interest. COPD is a progressive disabling disease affecting an estimated 900,000 people with a total annual cost to the NHS of £982 million including both direct and indirect costs.<sup>10</sup> There is often an ongoing burden on patients and their carers, and we need to know whether technology can reduce this burden and which outcomes can expect to be improved. A number of systematic reviews have attempted to summarise the evidence and to date little benefit has been reported.<sup>11,12</sup> In order to widen the scope of our literature search we have taken a narrative approach to explore the evidence in favour of technology for the monitoring or management of respiratory patients.

## Method

This review was undertaken using a narrative synthesis approach to examine a broad range of literature in order to provide an overview on the topic of technology and respiratory care in an attempt to understand the current level of NHS commissioning of telemonitoring facilities. Furthermore, in this narrative review we sought literature pertaining to a variety of technologies, from management systems to hand held devices, to assess the support for each technology and to distinguish areas for future research.

Publications on asthma and COPD that were linked with telemedicine, telemonitoring, e-health, telehealth, telecare, electronic monitoring and health technology were sought by searching the following databases: Pubmed; Cochrane Library; and Google – for information in the public forum, including government agencies and patient advocacy websites. Key words and terms used in the search were: COPD; asthma; telem\*; ehealth; electronic monitoring; health technology; telehealth; telecare; and NHS. The results for asthma and COPD are displayed in separate tables (Tables 1 and 2). The truncation of telemedicine and telemonitoring words to telem\* (use of wild card term) could only be utilised in the Pubmed searches and the full term/word was used in both Cochrane and Google searches. Similarly, National Health Service was shortened to NHS to provide consistency for all three database searches. For the purposes of this narrative review duplicates were not removed from the numerical results of the search strategy since the focus was a narrative synthesis of the literature.

**Table 1. Asthma search strategy and results.**

Diagnosis and Search term	Pubmed n=	Cochrane Library n=	Google n=
<i>Asthma and</i>			
1 telem* = telemedicine and telemonitoring	82	1	97,000 22,200
2 ehealth	3	0	179,000
3 electronic monitoring	77	1	74,100
4 health technology	269	4	350,000
5 telehealth	4	2	180
6 telecare	15	0	535
1 and NHS	0	0	11,000 1,010
2 and NHS	0	0	15,900
3 and NHS	0	0	9,080
4 and NHS	4	0	49,300
5 and NHS	0	0	5,630
6 and NHS	0	0	5,680
<b>TOTAL</b>	<b>454</b>	<b>8</b>	<b>820,615</b>

**Table 2. COPD search strategy and results**

Diagnosis and Search term	Pubmed n=	Cochrane Library n=	Google n=
<i>COPD and</i>			
1 telem* = telemedicine and telemonitoring	65	5	39,400 18,900
2 ehealth	5	1	32,300
3 electronic monitoring	15	2	18,900
4 health technology	115	5	134,000
5 telehealth	12	2	24,100
6 telecare	14	2	12,400
1 and NHS	2	0	10,100 871
2 and NHS	0	0	9,990
3 and NHS	0	0	5,010
4 and NHS	5	0	14,900
5 and NHS	0	0	12,200
6 and NHS	1	1	8,650
<b>TOTAL</b>	<b>234</b>	<b>18</b>	<b>341,721</b>

## Results

A plethora of technology-based monitoring studies have been undertaken in the last decade using a variety of methodologies. Monitoring of respiratory conditions by both health care professionals and patients is strongly recommended in both asthma and COPD guidelines.<sup>12</sup> In some instances the guideline itself forms the basis of the technological intervention as part of a decision-making system for clinicians in primary care and other health care providers.<sup>13,14</sup>

### Asthma

Asthma monitoring has been the focus of extensive research in the past decade. Many of these studies have focused on patient monitoring through the use of diary cards,<sup>15</sup> peak flow meters<sup>16</sup> and symptom scoring,<sup>17</sup> with the ultimate aim of improving patients' awareness and self management behaviour. Asthma studies using technology studies have also sought to manage, prompt and change behaviour.<sup>18,19</sup> More recently, there has been a focus on data mining of electronic records for case finding of co-morbid conditions.<sup>20,21</sup> However, much of the technology-based asthma literature pertains to various types of case management, including measures for surveillance to facilitate various formats of outreach care and education.<sup>4,22-25</sup> Technology has also been used as a patient compliance feature through an electronic patient alert and dispensing log system utilizing an audio reminder alert.<sup>26</sup> However, at the heart of quality asthma care is the concept of shared decision making, and asthma guidelines strongly promote this concept.<sup>27</sup> If asthma care concordance between patient and provider is to be achieved, the question of whether technology impacts on this process is yet to be ascertained.

### COPD

For people with COPD, acute exacerbations of COPD symptoms (AECOPD) are common; whilst some are unreported<sup>28</sup> others result in visits to the emergency department and hospitalisation,<sup>29</sup> and exacerbations of the disease are the feature most feared by patients.<sup>30</sup> A third of these patients will be seen again or admitted to hospital within the subsequent eight weeks.<sup>31</sup> This would seem to be an area where good studies are needed to determine whether technology can aid identification of those making a delayed recovery and to prompt identification of those needing further treatment or readmission. Recent studies have not provided the evidence needed to support the addition of technology and have contained methodological issues concerning small sample sizes,<sup>32-34</sup> lack of allocation concealment,<sup>35</sup> and additional access to health services available to patients in the technology arm.<sup>36</sup> Patients with recurrent AECOPD have been identified as having a more rapid decline in lung function<sup>37</sup> and a reduced quality of life.<sup>38</sup>

As yet the case for the addition of monitoring and management technologies to current 'best' practice for the ongoing care of COPD patients is weak and usual care in some studies may not meet 'best' practice standards for this patient group – such as outreach programmes, hospital at home, and early supportive discharge services espoused in national and international guidelines.<sup>39,40</sup> For COPD patients who undertake pulmonary rehabilitation there is some evidence that technology may be useful as a motivator to sustain the exercise component after the initial programme is completed.<sup>41</sup>

### Technology versus face to face

At present there is evidence that patients 'are positive towards' health technology<sup>8,42,43</sup> although the clinical benefit has not been firmly established.<sup>44</sup> As many people with severe COPD are housebound, a cyber link to the health professional through telemonitoring may be enticing to some hospital and primary care trusts. As a preliminary it is therefore important to establish how many of our patients with COPD, particularly those in the severe disease group, have internet access, a terrestrial phone line and are capable of using this type of telecommunications. Furthermore, as regards patients who rely on the technology to convey their health status to the health team, this may in itself create another area of research since no studies thus far have explored the emotional effects on patients and their carers when the telemonitoring service is withdrawn. Understanding any emotional impact is particularly important for any COPD population as co-morbid conditions such as anxiety and depression are already well documented in this patient group.<sup>45</sup> In the US, telemonitoring has been expanded to the realm of 'standard' care and is currently offered by some insurance companies (for a number of reasons), with a reduction in face-to-face nurse visits, without supporting evidence of better health outcomes.<sup>46</sup>

### Cost and benefit

In assessing the cost and benefit of technology, the cost of the technology and the time to view the data is rarely reported. Primarily, the reduction of current service cost seems to warrant the attention of a number of studies.<sup>7,33</sup> It is unclear from some of the published studies on technology whether researchers were required to pay for the equipment used to undertake the research. The added costs of providing telecommunications and additional equipment such as weight scales<sup>47</sup> to these patients are unknown, as are the costs for the ubiquitous technology upgrades and criteria such as which patients should have the service and over what period of time is required for maximal clinical improvement.

### Methodological Issues

Innovation and new technology is exciting and to be welcomed and we advocate that there is an urgent need for clinical trials of health technology for the monitoring of those

with asthma and COPD and that money should not be spent on such interventions outside clinical trials. Such studies should be robust in design and regarded as the norm for such interventions in a similar way that we expect trials of new pharmaceutical agents to be undertaken. One study found that 25% of their COPD study population had severe comorbid conditions and were subsequently excluded, as were a further 10% of patients due to problems associated with health literacy or not having a terrestrial phone line.<sup>36</sup> Inclusion and exclusion criteria of published studies thus raise issues associated with the use of health technology and social disadvantage. A more rigorous approach to such interventional research is needed to provide answers to questions associated with the advantages and disadvantages for this proposed addition to care.

## Discussion

Despite there being a large number of studies of a variety of technologies it remains difficult to ascertain the exact role and benefit which technology offers the health care system. In a recent heart failure study, technology was perceived to have a reduced impact due to the high quality of standard care by the outreach heart failure nursing team.<sup>48</sup> Cowie and colleagues' findings concur with other research on the effect of multidisciplinary teams (MDTs) which demonstrate that when best practice is operationalised there may not be a need for additional services.<sup>49</sup> Whilst technology may assist in the management of patients alongside best practice, it remains to be seen if there is a reduction in mortality, morbidity – and conversely an increase in quality of life – that can be solely assigned to the addition of technology.

While the arguments in favour a technological intervention such as the monitoring of patients in their home is plausible, it is unclear if technology either promotes the resolution of symptoms and/or empowers the patient to self manage their condition or both. Self management education and the use of action plans can alter patient behaviour with a beneficial effect on outcomes,<sup>29,50</sup> and monitoring via the use of technology may be used to reinforce such behaviour – but its benefits need to be proved. Equally it is possible that dependence upon advice received back in response to technology-based monitoring could reinforce dependent behaviours. Such a worse case scenario may see patients passively accepting the tele-commuted information and then consequently the dissolution of concordance in health care decision-making begins. Studies that tease out the issues connected to patient monitoring and an understanding of the factors involved in the patient's transition to self management through the use of technology are needed. In asthma, a number of studies have sought to understand how technology can be used effectively in self management, and

as yet the benefit for the use of this type of intervention remains unclear.<sup>4,51</sup>

Many of the systematic reviews of technological-based interventions highlighted methodological concerns. Drug development has well established interconnected processes from early development through to human trials, and this procedural approach may benefit future technology-based studies.<sup>52</sup> Due to the limited longevity of technology, it would be reasonable to consider fewer stages in technological assessment, but the real-time studies need to be in large populations to provide definite evidence of benefit. The role of the National Institute for Health and Clinical Excellence (NICE) in assessing the benefits of technology has become clear with their recently-released 'Guidance for technology appraisal'.<sup>53</sup> The transparency within both of these research and evaluative processes needs to be at the forefront of any health technology study to ensure that sound evidence can be translated into health service practice.

From a patient perspective, some studies suggest that patients with severe illness are accepting of care and rarely voice concern; however, we believe this not to be a reason to advocate advancement in technology without robust discussion.<sup>54</sup> The impact of information governance policy and procedures on the use of technology in case management is yet to be determined as the NHS strives to contain breaches in patient information and the loss of computerised data. If many of these technology-based studies are to be translated into clinical care then clearly the transmission of identifiable patient information through telecommunication networks may need further wide-ranging discussion. This canvassing of opinion and development of policy will be crucial given the recent experience of the NHS's comprehensive record system (CRS) and the NHS patients' forum on this topic.<sup>55,56</sup> Finally, the need for robust studies that include diversity and information governance assessments are required to understand the benefit or limitations which technology has to offer the health service and patients with chronic respiratory conditions.

## Conclusion

Although there may be an enormous potential for telemonitoring and the use of other forms of technology to assist in the provision of better care for those with long term respiratory diseases, at the present time there are too many unanswered questions for the implementation of this form of health technology across the NHS. More robust studies, and answers to clear research questions for specific patient populations, are needed, but we remain hopeful that telemonitoring and the use of technology as a supplement to best practice may prove to be a useful addition to the UK NHS.

**Conflict of interest**

None to declare.

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