Refereed paper

The impact of telehealth support for patients with diabetes or chronic obstructive pulmonary disease on unscheduled secondary care utilisation: a service evaluation

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ABSTRACT

Background Telehealth has been promoted as an adjunct to managing patients with long-term conditions. It has been used in various settings and for different disease groups. However, robust evidence for the efficacy of telehealth is currently lacking.

Objectives To evaluate the impact of a telehealth service on emergency admissions and emergency department (ED) attendances.

Methods We evaluated a telehealth service providing supported self-management to patients that was implemented in Nottingham City. Two groups of patients ('graduates' of the Nottingham telehealth service and service 'decliners') were compared for two periods; 2009 (pre-service implementation) and 2011. Eighty-nine pairs of graduates and decliners were identified who were matched for age and sex. The number and cost of emergency admissions and ED attendances for these patients were then collated and analysed.

Results Graduates had significantly fewer emergency admissions and ED attendances compared with decliners in 2011. However, differences of a similar magnitude in emergency admissions and ED attendances were found in 2009. Telehealth service users were likely to be qualitatively different from decliners, reflecting a degree of self-selection. This suggests that decliners were more likely to have a confounding reason for not engaging with telehealth, such as greater disease severity.

Conclusions This service review found no evidence that the Nottingham telehealth service has had a significant impact on secondary care utilisation in the short term. Longer term follow up is needed to establish conclusively whether telehealth initiatives like the Nottingham telehealth service does lead to tangible patient benefits and provide value for money.

Keywords: chronic disease, evaluation, self-management, telehealth

What is known
- The benefits of telehealth services are likely to be dependent on patient selection and engagement.

What this paper adds
- Patients who use telehealth support are qualitatively different from non-users, and indicate a degree of self-selection.
- In the short term, telehealth support to patients with COPD or diabetes does not reduce unscheduled secondary care utilisation.

The full health impact of telehealth support may not be evident in the short term.

Background

Health services in England face a challenging task of meeting the needs of a growing aged population, with their attendant burden of ill health, against a backdrop of funding and resource constraints in the next decade.[1] It is estimated that the number of people over the age of 65 years will increase by 28% between 2010 and 2035.[2] The size of the burden of chronic ill health, including diseases such as diabetes mellitus, chronic obstructive pulmonary disease (COPD) and heart failure, is also on the increase. Many of these long-term conditions feature more prominently in this age group, and older patients are more likely to suffer multiple morbidities.[3,4] Telehealth and its associated technologies have been touted as one of the solutions to deal with this problem.[5–7] Telehealth refers to an array of communications technology used by health staff to deliver health and social care support to individual patients.[8] It has been tried for the management of a range of long-term conditions that include diabetes, mental health, cardiac disease, monitoring of high-risk pregnancies and frail elderly, and palliative care.[9–14] It has also been implemented in different settings and could be especially useful for the delivery of chronic disease care for more remote and rural areas.[15]

Studies of effectiveness have reported that telehealth can reduce the rates of emergency department (ED) attendance, hospital admissions and hospital lengths of stay for patients with long-term conditions.[16–18] It has also been reported to reduce mortality rates.[18,19] One particular telehealth scheme, Birmingham's *OwnHealth* service, reported that their telephone-based programme of nurse-delivered motivational coaching and support for self-management for patients with poorly controlled diabetes led to improvements in health outcomes, such as better blood pressure control, reductions in body mass index and reductions in glycosylated haemoglobin (HbA1c) levels.[13] Although there have been anecdotal reports of the potential benefits of telehealth, robust evidence of its effectiveness is lacking.[12,20] In 2009, NHS Nottingham City commissioned a telehealth service based on a similar service provided in Birmingham. Here, we present the results of a retrospective evaluation of the service carried out in 2011/12 looking in particular at whether the service has had an impact on emergency admissions and ED attendance for a cohort of service 'graduates'.

Methods

The Nottingham telehealth service is a proactive telephone-based care management service for people with long-term conditions with a focus initially on patients with a primary diagnosis of diabetes or COPD. One of its objectives was 'to ensure more appropriate utilisation of unscheduled care services, e.g. reductions in ED attendance, unplanned admissions to hospital, primary care demand (in- and out-of-hours)'. Patients suitable for the service are identified by their general practitioner (GP) if they have poorly managed diabetes or COPD without complex needs. With the patient's agreement, the general practice sends to the Nottingham telehealth service a minimum patient dataset that includes demographic information as well as their contact details. The Nottingham telehealth service then contacts the patient to explain the service and invite them to enrol. Enrolled patients are regularly contacted by the telehealth service on at least a monthly basis. Using motivational coaching, the care managers help patients make lifestyle changes to improve their health. They also work with patients and their carers to help them understand their condition and their medication, thereby enabling self-care.

Patients are deemed to have 'graduated' from the service once they have received at least 12 months of care management support following completion of an initial assessment, completed a care review, and are judged by the telehealth service as being able to self-manage their condition. Patients that are actively managed for more than one condition, in order to graduate

from active management, also require to not have had any condition-related hospitalisations and no more than one condition-related ED attendance in the preceding six months.

Secondary care usage by the telehealth service graduates was compared against patients who were identified by their GPs as meeting the telehealth service criteria but declined to use the service. The telehealth service graduates were selected as the study group as it was considered that if the telehealth service was having a beneficial impact the benefits were most likely to be observed in this cohort of patients. The comparator group (service decliners) was chosen on the basis that they were most likely to be similar to those patients enrolled by the telehealth service.

In the first 28 months of the service, 901 patients were enrolled. At the time of the review, all graduates of the service were initially included for the evaluation. This amounted to a total of 94 patients that had graduated from the service between April and December 2011. Of the 94, only 89 of the graduate group were still resident in Nottingham City with the other five patients having either moved out of area or died. The analysis described below examined this group of 89 graduates, identified as 'graduates'. A separate internal evaluation by the service provider was also carried out, looking at patient satisfaction, impact on primary care quality outcome framework (QOF) indicators. This is also presented in the results section.

Three hundred and ten patients who had been referred to the telehealth service by their GPs but declined to take up the service were also identified. In order to ensure that we were comparing similar cohorts of patients, the 89 graduates were matched for sex and age (5-year age bands) with comparable patients who were referred to but declined the service ('decliners'). Eighty-nine unique pairs were identified. One limitation of this evaluation was that the pairing was devised after service implementation had taken place. As a consequence, there was insufficient routinely collected data available to enable us to match the graduates and decliners further by condition, severity of condition, and comorbidities.

For both graduate and decliner groups we accessed the Secondary Uses Service database to determine the number of emergency hospital admissions, their length of stay for emergency hospital admissions, the emergency admission tariff, ED attendances and the ED tariff. All ED attendances and emergency hospital admissions were counted because it was not always possible to exclude attendances or admissions for unrelated conditions. In addition, because the graduates may be a self-selecting group with a pre-existing interest in managing their own health condition, we considered the possibility of selection bias affecting emergency hospital admissions and ED attendance rates. Any differences observed between the two groups could therefore reflect the inherent motivation of the 'graduates' group managing their condition, as opposed to any impact of the telehealth service. To address this, we therefore looked at the emergency admissions and ED attendances of the same two groups of 89 patients for two 12-month periods: January to December 2011 and January to December 2009. The earlier period was chosen because it predates the launch of the service and therefore reflects the pre-existing situation before the telehealth service could reasonably be expected to have had any impact.

The data was collated and analysed descriptively. Statistical significance for the quantitative results was evaluated using SPSS software. Given the small numbers in the samples and the lack of normal distribution of the variables, the chi-squared test was applied.

Results

Internal evaluation by the service provider

An internal evaluation by the service provider of the 901 enrolled patients reported high rates (93%) of user satisfaction. However, they found no impact on patients' willingness to engage in more physical activity, change smoking behaviour or alcohol intake. There was a small trend noted on diet, but this was not statistically significant. Some improvements were seen in the following primary care outcome measures (Table 1): there were reductions in HbA1c levels and mean body mass index. However, these could not be solely attributed to the service with any certainty and most probably reflect the effect of care provided by the patients' general practices.

Patient profile

There were 47 male and 42 female graduate–decliner pairs. The 70–74 years age band had the highest number of patients (26% of the study group). The youngest age band was 30–34 years. Although we were able to pair the two groups by age and sex, the small study size and limited patient data meant that it was not possible to pair graduate and decliner patients by comorbidity, disease severity or deprivation. However, the socio-economic profiles for the two groups, as measured by their Index of Multiple Deprivation (IMD) scores, were observed to be similar with the highest number of both patient groups occurring in the 40–50 IMD range.

Table 1 Clinical outcomes for patients enrolled on the Nottingham telehealth service 2010/11 (internal service evaluation data)

Test	*n*	Average baseline	Average difference	95% Confidence interval		*P*-value
				Lower limit	Upper limit	
Body mass index (kg/m^2)	194	27.9	–0.3	–0.7	–0.02	0.04
Systolic blood pressure (mmHg)	74	137.1	–1.6	–6.0	2.7	0.56
Diastolic blood pressure (mmHg)	74	75.3	–0.9	–3.4	1.7	0.62
Total cholesterol	62	4.6	–0.1	–0.4	0.2	0.17
HbA1c	90	8.27	–0.37	–0.69	–0.04	0.03
FEV1 %	29	53.4	2.3	–1.7	6.2	0.57

Emergency hospital admissions

Between January and December 2011, there were 32 emergency admissions amongst decliners; a rate of roughly 36 admissions per 100 patients (Table 2). This amounted to 172 bed days at a total cost of around £55 615. For graduates, there were 14 emergency admissions, a rate of around 16 admissions per 100 patients, accounting for 87 bed days at a total cost of around £27 799. The average lengths of stay were slightly higher for the graduate group than the decliner group (6.21 vs. 5.38 bed days, respectively). This crudely equated to an average cost of each emergency admission of £1738 per decliner and £1986 per graduate. Interestingly, if the median values were used to minimise the effect of outliers, the median length of stay was three bed days for decliners and four bed days for graduates, at an average cost of £1989 and £2065 respectively. When emergency hospital admission costs were examined by age, it was observed that the admissions were skewed towards the older age bands for the graduates group compared with the decliner group.

The number of emergency admissions, and the associated total costs, were significantly lower in the graduate group than the decliner group. This interpretation needs to be tempered by fact that sample sizes were small. In addition, the total tariff costs included admission spells coded as having £0 cost in both groups. This could be due to invalid or missing procedure or diagnosis codes returned by the healthcare provider. It was not possible to obtain these costs despite attempts to do so. There were more £0 cost returns for decliners than graduates (6 vs. 1 respectively), which raised the possibility that actual non-elective hospital admission costs for decliners may have been underestimated in the evaluation. When null cost returns were excluded, the average cost of emergency admissions was considerably lower for decliners (£1854) than graduates (£2138). Examination of the 2011 data appears to suggest that the Nottingham telehealth service graduates accounted for fewer emergency hospital admissions, fewer bed days and lesser overall health costs than decliners, and data from 2009 that predates the telehealth service intervention also found a similar pattern.

ED attendances

Over a 12-month period, the number of graduate ED attendances was found to be significantly lower than the number of decliner attendances (Table 3). There were 23 ED attendances ($\sim$ 26 per 100 patients) amongst decliners at a total cost of £2221. Amongst service graduates, there were 11 emergency attendances ($\sim$ 12 per 100 patients) at a total cost of £993. The average cost of each ED attendance was roughly similar at £97 and £90 for decliners and graduates, respectively. The age profile of ED attenders was also similar between the decliner and graduate groups. ED attendance was highest for those aged between 70 and 79 years. Once again, when pre-intervention data was looked at, the decliner group accounted for a higher number of ED attendances than the graduate group.

Discussion

Principal findings

The review found a significant difference between the secondary care utilisation of the graduate and decliner groups in 2011. However, differences of the same

Table 2 Non-elective hospital admissions, Nottingham City, 2011

	Data, 2011		Pre-intervention data, 2009	
	Telehealth decliners	Telehealth graduates	Telehealth decliners	Telehealth graduates
Age group (years)				
55–59	6	1	7	1
60–64	2	1	5	6
65–69	6	1	0	3
70–74	9	4	10	5
75–79	6	6	4	2
80–84	1	0	11	0
85+	1	1	0	0
Gender				
Male	14	6	15	8
Female	18	3	22	9
Number of admissions	32	14	42	17
Crude rate of admissions (per 100)	36	16	47	19
Total bed days	172	87	200	68
Bed days per admission (range)	0–36	1–21	0–77	0–28
Average length of stay for each admission (bed days)	5.38	6.21	5.41	4.00
Total cost of hospital admissions (using 2011 tariff/£)	55 615	27 799	71 140	23 231
Average cost per hospital admission (£)	1738	1986	1694	1367
Cost per hospital admission (range/£)	0–5560	0–4093	0–5948	£0–2797

magnitude were also observed between the groups in 2009. The decreases in secondary care use observed in both groups between 2009 and 2011 are probably due to other confounders such as broader service improvements in both primary and community care. In addition, the high rates of hospital use by the decliner group suggest that this group may have a greater pre-existing burden of disease. The graduate group probably tends to be less unwell and more able to self-manage their condition. Paradoxically, it is the decliner group of patients where supported self-management has the greatest potential to deliver benefits who are the ones least likely to be recruited into telehealth programmes. This review therefore found no evidence that the telehealth service has had a significant impact on the use of secondary care services.

Comparison with the literature

There are conflicting reports of the health benefits of telehealth initiatives; although some studies report finding benefits, others do not.[12,14,18,20,21] One possible explanation is that the benefits of telehealth are likely to be dependent on patient selection, which our data supports.[22] Many studies for telehealth have also focused on patient satisfaction and feasibility, and very little has been reported on its cost-effectiveness.[8] This is backed up by a recent Cochrane review that highlighted the need for further evidence of the cost-effectiveness of telehealth.[23] However, the calculation of costs is not straightforward. As Wooton and Herbert (2001) observed over a decade ago, 'the calculation of cost requires some care, since it depends on assuming a particular financial perspective (the patient's, the healthcare provider's, or society's)' as well as the context in which the service is being delivered in.[24]

Table 3 A&E attendances, Nottingham City, 2010/11

	Data, 2011		Pre-intervention data, 2009	
	Telehealth decliners	Telehealth graduates	Telehealth decliners	Telehealth graduates
Age group (years)				
50–54	0	0	1	1
55–59	3	1	6	1
60–64	1	1	5	4
65–69	1	1	0	1
70–74	6	1	6	3
75–79	7	5	6	3
80–84	3	0	3	1
85+	1	1	0	0
Gender				
Male	10	4	13	8
Female	12	6	14	6
Attendance tariff level				
High (£117 per attendance)	12	4	24	11
Standard (£87 per attendance)	6	4	3	2
Minor (£59 per attendance)	5	3	7	2
Number of A&E attendances	23	11	34	15
Crude rate of A&E attendances (per 100)	26	12	38	17
Average cost per A&E attendance (£)	97	90	102	105

Implications of the findings

Patients who used our telehealth service were qualitatively different from those who declined the service. This probably reflects either self-perception of need for this service,[25] patient acceptance of the technology[26] or a self-selection bias where 'activated' patients with greater confidence of their ability to self-manage their condition are more likely to proactively take it up.[22] Any health benefits accrued were not evident for this group of patients, which diminished the value and overall effectiveness of the service . This echoes findings from a review by Joseph *et al*[27] which identified recruitment of the right patients for telehealth as a key factor for successful implementation.

In addition, the poor uptake and efficacy of our telehealth programme may be because healthcare professionals did not see it as part of routine care. This lack of engagement by healthcare professionals and the failure to normalise its use have been reported elsewhere as a potential barrier to the implementation of telehealth.[28,29] Another explanation for the apparent lack of benefit of telehealth may be that we are looking for health outcomes linked to the long-term value of telehealth, but measuring it with indicators specific to short-term projects.[30] Finally, our study reiterates the need for service evaluations to include before- and after-intervention data capture lest observed differences resulting from trends are erroneously attributed to the intervention.

Limitations of the method

We are mindful of the small number of patients used for the analysis, as well as the self-selection bias both by patients opting to partake in the service, and those declining the service. In addition, as noted above, the evaluation defined service 'benefits' in terms of reductions in the use of secondary care services and did not consider benefits in terms of patient level clinical indicators, for example blood pressure, HbA1c. Consequently, it may have been optimistic to expect to observe differences so soon after service implementation especially if the graduates are at the early stages of their disease. It may be useful to follow

longitudinally a group of service users and decliners over 5 and 10 years as their condition progresses.

Conclusions

This service review found no evidence that the telehealth service has had a significant impact on secondary care utilisation in the short term. Longer term follow up is needed to establish conclusively whether telehealth initiatives like the Nottingham telehealth service does lead to tangible patient benefits and provide value for money. However, in view of the existing resource constraints currently experienced by health commissioners in the UK, it is difficult to justify on-going investment in telehealth based on limited evidence for its cost-effectiveness.

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