

Information in practice



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Virtual outreach: economic evaluation of joint teleconsultations for patients referred by their general practitioner for a specialist opinion

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Abstract

Objectives To test the hypotheses that, compared with conventional outpatient consultations, joint teleconsultation (virtual outreach) would incur no increased costs to the NHS, reduce costs to patients, and reduce absences from work by patients and their carers.

Design Cost consequences study alongside randomised controlled trial.

Setting Two hospitals in London and Shrewsbury and 29 general practices in inner London and Wales.

Participants 3170 patients identified; 2094 eligible for inclusion and willing to participate. 1051 randomised to virtual outreach and 1043 to standard outpatient appointments.

Main outcome measures NHS costs, patient costs, health status (SF-12), time spent attending index consultation, patient satisfaction.

Results Overall six month costs were greater for the virtual outreach consultations (£724 per patient) than for conventional outpatient appointments (£625): difference in means £99 (\$162; €138) (95% confidence interval £10 to £187, $P=0.03$). If the analysis is restricted to resource items deemed "attributable" to the index consultation, six month costs were still greater for virtual outreach: difference in means £108 (£73 to £142, $P<0.0001$). In both analyses the index consultation accounted for the excess cost. Savings to patients in terms of costs and time occurred in both centres: difference in mean total patient cost £8 (£5 to £10, $P<0.0001$). Loss of productive time was less in the virtual outreach group: difference in mean cost £11 (£10 to £12, $P<0.0001$).

Conclusion The main hypothesis that virtual outreach would be cost neutral is rejected, but the hypotheses that costs to patients and losses in productivity would be lower are supported.

Introduction

Between 6% and 10% of contacts between patients and primary care result in a referral for a specialist opinion.¹ Studies in the Netherlands have shown that involvement of general practitioners in joint consultations with specialists can lead to better patient

management, reductions in hospital follow up appointments, fewer tests and investigations, improvements in health status one year after referral, and fewer subsequent referrals to hospital.^{2,3}

A videoconferencing link avoids the need for all participants to be in the same place, while potentially offering the same benefits in communication. However, very little has been published on the cost effectiveness of teleconsultation—"real time" consultations in which doctors and patients are separated geographically but communicate through the use of videoconferencing.⁴ This economic evaluation of the virtual outreach project, the largest reported randomised trial of teleconsultations, thus provides important new information.

Methods

The design of the trial, details of the method, and other outcomes have been described in full elsewhere.^{5,6} The investigators established virtual outreach services in the Royal Free Hampstead NHS Trust in inner London and the Royal Shrewsbury Hospital Trust in Shropshire. Virtual outreach involved a "real time" joint consultation between the general practitioner, present with the patient in the practice, and consultants in the hospital. The general practitioners referred a total of 3170 patients, of whom 2094 consented to participate in the study and were eligible for inclusion. The investigators randomised 1051 patients to the virtual outreach group and 1043 to standard outpatient appointments; they followed participants for six months after their index consultation. The hypotheses of the economic evaluation were that, compared with conventional outpatients, virtual outreach would incur no increased costs to the NHS; reduce the costs incurred by patients attending outpatient appointments; and reduce the time taken off work, so having a positive impact on productivity.

Costs to the NHS

The economic evaluation focused on actual resources used. We derived a cost for each patient for the index consultation and the six month follow up period.



Members of the project group and participating professionals appear on bmj.com

Index consultation

We costed the consultations to which patients were randomised by using an “ingredients” approach.⁷ The main ingredients were capital and overhead costs, professionals’ time, and telephone line costs. We estimated professionals’ time by using observation by non-participants of a small sample of consultations selected opportunistically. Table 1 gives the complete record for the timing of index consultations. Table 2 summarises the ingredients costs for each type of consultation.

The cost of general practitioners’ time, based on data compiled by Netten and Curtis,⁸ was £1.96 (\$3.22; €2.73) a minute, including practice overheads and training costs. We estimated the cost of a minute of consultants’ time as £2.90. To ensure comparability between general practitioner and consultant costs, we derived the cost of consultants’ time by adding nursing and clinic costs supplied by the Royal Free Hampstead NHS Trust to Netten’s figure of £1.82, which includes an allocation for secretarial support but not the overheads associated with running an outpatient clinic.

In addition to the normal overheads incorporated into the labour costs of general practitioners and consultants, new overheads are incurred by virtual outreach. We assigned these costs, which included rental of an ISDN line and installation of software, to individual consultations by dividing the total cost by the number of teleconsultations. A total of 889 teleconsultations took place in the virtual outreach project over 21 months—approximately 500 teleconsultations per year. We therefore divided the equivalent annual cost by 500 to derive a capital cost per consultation.

Prescription data

We collected prescription data and costs electronically from the computerised record systems of general practices. We collected prescription data for patients for the six months either side of the index consultation. We deemed a prescription issued after the index consultation to be “attributable” to the index consultation if the patient did not receive the same named prescription in the six months before the index consultation.

Tests, investigations, procedures, and contacts with healthcare services

Using a standard form and coding system, research nurses collected data from hospital and practice records on participants’ use of NHS resources in the six months after the index consultation. We assigned a unit cost to each resource item (table 3). We obtained these from 1999-2000 data from the Royal Free Hampstead NHS Trust, the Royal Shrewsbury Hospital Trust, and *NHS Reference Costs 2000*,⁹ except for the costs of consultations, which we derived from Netten and Curtis.⁸ Much of the use of resources over the six months was unrelated to the condition that led to the patient’s recruitment into the trial. We developed criteria for identifying items of resource use that could be deemed to be attributable to the index consultation specialty—for example, a gastroscopy for a patient referred to a gastroenterologist. We classified other non-specific items as attributable if they occurred within four weeks of the index consultation. We based all costs to the NHS on actual rather than prescribed resource use, in order to reflect true clinical practice.

Costs to the patient and impact on productivity

We used a postal questionnaire to collect data on the costs incurred by patients as a direct result of their index appointment. We asked patients to record any travel costs incurred by themselves or anyone accompanying them and the time taken, including travel time, to attend the index consultation. We also collected information about the impact on the paid work of patients and anyone accompanying them. If any work time was lost, the questionnaire asked about whether pay was reduced or whether anyone had taken annual leave. We estimated productivity losses identified by using data from the *New Earnings Survey*.¹⁰

Statistical methods

The statistical analysis used for the economic evaluation followed a prespecified plan based on the groups as randomised. We used *t* tests to investigate differences in costs to the patient and the NHS between the two arms of the trial.¹¹ We carried out adjusted analyses by using multiple ordinary least squares regression with adjustments for site (London or Shrewsbury), specialty (orthopaedics; urology; ear, nose, and throat; gastroenterology; or other), age at randomisation, sex, and baseline overall score on the Duke severity of illness inventory.¹² In addition, we used tests of interaction to investigate whether the effect of virtual outreach varied by site or specialty.

Sensitivity analysis is used to explore the robustness of results when uncertainty exists about the assumptions. In this trial, the key uncertainty concerned the costs of the index consultation. We therefore did one way sensitivity analysis on the key parameters associated with the index consultation.

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Table 1 Timings from a sample of consultations

	Mean (SD) minutes	Range (minutes)	95% confidence interval
Joint teleconsultation			
Duration of consultation (n=31)	10.5 (5.1)	3-22	8.6 to 12.4
Total time: general practitioner (n=14)	26.0 (10.1)	9-45	20.2 to 31.8
Total time: consultant (n=22)	19.9 (8.3)	8-37	16.2 to 23.6
Conventional outpatient appointment			
Duration of consultation (n=35)	9.3 (5.2)	3-25	7.5 to 11.0
Total time: consultant (n=35)	11.8 (6.2)	5-27	9.7 to 13.9

Table 2 Cost of an index consultation

	Virtual outreach (£)	Standard outpatients (£)
Labour:		
General practitioner	50.96	NA
Consultant	57.71	34.22
Consumables:		
Call charges	0.71	NA
Capital:		
Videoconferencing units	23.52	NA
Trolleys	0.12	NA
Cabinets	0.10	NA
Overheads:		
ISDN rental	31.50	NA
Software installation	12.37	NA
ISDN installation	15.19	NA
Marginal cost of consultation	109.38	34.22
Average cost of consultation	192.17	34.22

NA=not applicable.

Table 3 Use of resources during the six month follow up period, with unit costs

Item	Mean (SD) use of resources		Unit cost or range (£)	Source of unit cost*
	Virtual outreach (n=1033)	Standard outpatients (n=1025)		
Primary care services:				
General practitioner	2.40 (2.59)	2.27 (2.39)	25	1
Practice nurse	0.73 (1.49)	0.63 (1.32)	9	1
Other clinical staff	0.04 (0.38)	0.06 (0.43)	9	1
Home visits	0.05 (0.30)	0.07 (0.44)	45	1
Other contacts	0.25 (0.68)	0.24 (0.74)	6-20	1, 2
Contacts between hospital and practice	0.24 (0.62)	0.16 (0.49)	19	1, 2
Tests, investigations, and procedures:				
Radiological investigations	0.48 (0.95)	0.54 (0.92)	36-580	3, 4
Blood tests and laboratory investigations	2.36 (3.93)	3.01 (4.57)	1.02-236	3, 4
Other tests and investigations	0.39 (0.74)	0.46 (0.77)	2.58-990	3, 4, 5
Hospital services:				
Visits to outpatient departments	1.32 (1.57)	1.28 (1.59)	9-127	1, 3, 4, 5
Inpatient admissions	0.11 (0.35)	0.13 (0.39)	76-218/day	3, 4
Accident and emergency	0.06 (0.30)	0.06 (0.28)	112	3
Day surgery and other inpatient procedures	0.11 (0.36)	0.12 (0.38)	29-4956	3, 4, 5
Other hospital visits	0.07 (0.30)	0.12 (0.42)	9-71	3, 4, 5
Other hospital contacts	0.05 (0.26)	0.09 (0.36)	6-18	1, 2
Prescriptions:				
No of patients	852	859		
Prescriptions	8.72 (12.97)	8.15 (12.53)	0.03-466	6

*Sources of unit costs: 1=Netten and Curtis⁶; 2=general practitioner estimate; 3=Royal Free Hampstead NHS Trust; 4=Royal Shrewsbury Hospital Trust; 5=NHS Reference Costs 2000⁶; 6=computerised records at general practices.

Results

From a total of 3170 eligible patients, the study included 2094 patients. Of these, 15 later withdrew their consent. One thousand and fifty one participants were randomised to virtual outreach consultations and 1043 to standard outpatient appointments.

Costs to the NHS

Index consultation—Table 2 gives the costs for the virtual outreach consultations and standard outpatient consultations. A total of 225 patients did not attend their index consultation, 155 in the virtual outreach group and 70 in the standard outpatient group. Assuming that the NHS did not incur any costs as a result of the non-attendance of patients in the trial, the estimated mean cost of a patient's index consultation was £164 in virtual outreach and £32 in standard outpatients, a difference of £132 (table 4).

Prescription costs—We found no significant differences between the costs in the two arms of the trial overall (table 4), nor by site or specialty. Basing the analysis on the subset of "attributable" prescriptions also failed to show any significant differences.

Costs of tests, investigations, and contacts with healthcare services—We divided the use of NHS resources in the six months after the index consultation into those associated with primary care visits and contacts, secondary care visits and contacts, and tests and procedures (tables 3 and 4). In none of these categories did a significant difference occur between the two arms of the trial, and this remained so after adjustment for baseline characteristics. As reported elsewhere,⁵ the number of tests was larger in the standard outpatients group, and this is reflected in the higher mean costs for tests and procedures.

Total NHS costs—We estimated the total mean costs to the NHS as £724 per patient in the virtual outreach

group and £625 per patient in the standard outpatient group, a difference of £99 (95% confidence interval £10 to £187, $P=0.03$). When we restricted the analysis to "attributable" resource use (table 4), costs to the NHS were £393 per patient in the virtual outreach group and £286 per patient in the standard outpatient group. The mean difference of £108 (£73 to £142) was similar to that obtained for total resource use but was highly significant ($P<0.001$). Adjustment for baseline characteristics did not greatly affect these results.

Costs to patients

A total of 1597 (77%) patients returned questionnaires—777 (74%) in the virtual outreach group and 820 (79%) in the standard outpatient group (table 4). Patients in the virtual outreach group incurred lower transport costs for the index consultation than those in the standard outpatients group. The mean difference in travel cost was £3.40 ($P<0.0001$). In addition, mean childcare costs arising from the index consultation were £0.37 ($P=0.02$) lower for virtual outreach patients. The mean loss of pay for patients in the virtual outreach group was £2.53 compared with a mean of £6.46 in the standard outpatients group, a difference of £3.93 ($P<0.01$). Total patient costs were significantly lower in the virtual outreach arm, with a mean difference of £7.70 ($P<0.0001$).

Losses in productivity

On the basis of the time taken to attend the index consultation, potential productivity was greater in the virtual outreach arm. The mean improvement was £10.76 (£9.77 to £11.75, $P<0.0001$) per patient. We found little difference by site.

Consequences

The results in terms of health outcomes and health services outcomes have been described elsewhere.⁵ Contrary to the central hypothesis that fewer follow up

appointments would be needed in the virtual outreach group, a significantly greater proportion of patients in the virtual outreach group were offered a follow up appointment (intention to treat analysis, 52% *v* 41%; odds ratio 1.52 (1.27 to 1.82), $P < 0.0001$). No difference in health outcomes occurred at six months according to the physical and psychological scores of the SF-12 and child health questionnaire. Patient satisfaction, measured with the Ware specific visit questionnaire,¹⁴ was significantly higher in patients who had a virtual outreach consultation—difference in means 0.33 (0.23 to 0.43), $P < 0.0001$. A measure of the extent to which patients feel able to cope after a consultation showed no significant differences between the two arms of the trial.

Sensitivity analysis

The results of the one way sensitivity analysis are given on bmj.com. Virtual outreach appointments remained more expensive in all scenarios. The magnitude of the difference in costs was particularly sensitive to the duration of the teleconsultation, reflecting the importance of clinicians' time.

Discussion

The analysis based on total use of NHS resources over six months shows that overall the mean cost per patient was significantly higher in the virtual outreach group than in the standard outpatients group by almost £100. When we restricted the analysis to attributable resource data the mean cost per patient was £108 more in the virtual outreach group. This attributable analysis is likely to reflect the true position more accurately, because of the "noise" inherent in an analysis based on total resource use.

We based the hypothesis that virtual outreach would not lead to increased costs to the NHS on the expectation that better patient management arising from improved communication would lead to "down-

stream" savings. The results as presented here do not provide evidence that such savings exist. Although virtual outreach led to a significant reduction in tests and investigations,⁵ this resulted in only small downstream cost savings because the greatest difference between the two groups occurred in low cost routine tests. However, a six month follow up period may have been too short to enable us to detect such savings, as these would have to have been large to compensate for the additional costs of the index teleconsultation.

The "ingredients" based cost used could overestimate costs for several reasons. Firstly, the average cost of a virtual outreach consultation is in some respects an artefact of the trial, as the cost per consultation depends critically on the number of consultations.¹⁵ We included the marginal cost of a consultation to take this into account (table 2). Secondly, the technical failures of virtual outreach are likely to be a function of training, experience, and the state of technology; they could potentially be reduced, leading to more efficient use of physicians' time. Thirdly, ISDN lines and videoconferencing equipment had to be installed and purchased specifically for the purposes of the trial. In future, virtual outreach services would use existing facilities in the hospital and general practices. Finally, the problems of evaluating emerging telemedicine technology have been well documented.¹⁶ By evaluating the teleconsultations at a fixed point in time, we could not incorporate changes in quality or price of information technology and telecommunications equipment. The technology used in the trial was basic; the price of such equipment might fall, or subsequent technology may be more sophisticated and consequently more costly.

Patients attending a teleconsultation incurred significantly lower transport costs than did those attending conventional outpatient appointments, although the magnitude of the difference (£3) was

Table 4 Summary of costs (£) by sector. Values are means (SDs) unless stated otherwise

Cost	Virtual outreach (n=1044)	Standard outpatients (n=1035)	Difference (95% CI)	P value
NHS costs*:				
Index consultation†	163.64	31.91	–	–
Primary care visits and contacts‡	75.11 (77.40)	70.41 (72.14)	4.70 (–1.74 to 11.14)	0.15
Secondary care visits and contacts‡	188.76 (532.28)	208.08 (1068.86)	–19.32 (–91.86 to 53.21)	0.60
Tests and procedures‡	182.21 (403.23)	209.23 (384.31)	–27.02 (–60.90 to 6.87)	0.12
Prescription costs§	114.26 (206.48)	105.63 (173.62)	8.63 (–7.79 to 25.04)	0.30
Total NHS cost (imputed)	723.98 (832.07)	625.26 (1199.77)	98.72 (9.98 to 187.46)	0.03
Adjusted¶	–	–	101.79 (15.26 to 188.32)	–
Attributable NHS costs (imputed)	393.33 (388.93)	285.75 (406.95)	107.58 (73.35 to 141.82)	<0.0001
Adjusted¶	–	–	110.50 (76.79 to 144.21)	–
Patient costs**:				
Transport costs††	1.12 (3.06)	4.52 (8.18)	–3.40 (–4.02 to –2.79)	<0.0001
Lost pay‡‡	2.53 (16.58)	6.46 (32.51)	–3.93 (–6.48 to –1.38)	0.003
Childcare costs§§	0.03 (0.37)	0.40 (3.93)	0.37 (0.09 to 0.64)	0.01
Total patient costs (imputed)	3.69 (16.89)	11.38 (33.85)	–7.70 (–10.35 to –5.05)	<0.0001
Adjusted¶	–	–	–7.65 (–10.30 to –5.01)	–

*These data exclude 15 patients who withdrew their consent from the study.

†225 patients in the trial did not attend their index consultation: 155 patients in the virtual outreach group and 70 patients in the standard outpatient group. A zero cost has been assigned to the index consultation for these patients.

‡Values imputed for 21 patients with missing data; imputed value was mean cost for patients with data.

§Values imputed for 368 patients with missing data; imputed value was mean cost for patients with data.

¶Adjusted (by missing indicator method¹³) for age at randomisation, sex, specialty, site, and score on Duke severity of illness inventory.

**Based on questionnaires obtained from 1597 eligible patients six months after their index consultation.

††Values imputed for 163 patients with missing data.

‡‡Values imputed for 12 patients with missing data.

§§Values imputed for 70 patients with missing data.

What is already known on this topic

Videoconferencing allows joint consultations between the patient, general practitioner, and hospital specialist

The clinical reliability of telemedicine has been established, but very little has been published on its cost effectiveness

What this study adds

Virtual outreach consultations incur greater costs to the NHS than standard outpatient appointments

Virtual outreach consultations result in savings to patients in terms of costs and time

Adoption of virtual outreach cannot be justified on economic grounds

relatively small. Also, patients in the virtual outreach group reported significantly shorter time off work than patients in the standard outpatient group. The trial results provide good evidence that virtual outreach consultations are less time consuming and cheaper for patients and are likely to have a positive impact on productivity.

Considering total costs, little justification on economic grounds seems to exist for the adoption of virtual outreach. However, all the benefits may not have been recouped within the six month follow up period, and we did not estimate values of improved patient satisfaction. We may therefore have underestimated the beneficial consequences of virtual outreach. Furthermore, previous subanalysis showed that certain specialties may be more appropriate for virtual outreach than others,⁵ and improved selection of patients may also improve the relative cost effectiveness of virtual outreach.

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Corrections and clarifications

Head of ME Association is sacked

We added an incorrect title to this "news roundup" article by Owen Dyer (7 June, p 1232). As the first sentence of the article makes clear, it was the medical director (Dr Charles Shepherd) who was sacked from his position at the ME Association (a British charity for people with myalgic encephalomyelitis). Dr Shepherd was not the head of the association.

Canadian government is attacked for plan to legalise marijuana

In the currency conversions in the second paragraph of this "news roundup" article by David Spurgeon, we seriously overestimated, by a factor of four, the value of the Canadian dollar (7 June, p 1232). How we achieved this startling conversion rate has a bizarre explanation, but the correct conversions (for the new \$C100 fines facing people who are found to be in possession of less than 15 g of marijuana) are £45, \$US75, and €64.

Arsenal helps publicise testicular cancer website

Maybe the news team at the *BMJ* should show a bit more interest in football in their spare time. They managed to achieve only a 25% accuracy rate in assigning names to the four Arsenal players in the picture accompanying this news article by Susan Mayor (14 June, p 1282). They got the names right but (except for Kolo Toure) in the wrong order. In their defence, the order was the order provided by the organisation that supplied us with the photograph. An Arsenal supporter in the editorial office has assured us now that from left to right, the names are Kolo Toure, Stuart Taylor, Lauren, and Edu.