A PATIENT-INITIATED DMARD SELF-MONITORING SERVICE FOR PEOPLE WITH RHEUMATOID OR PSORIATIC ARTHRITIS ON METHOTREXATE: A COST-EFFECTIVENESS ANALYSIS

Hayley McBain[1*], Chris Flood[1*], Michael Shipley[2], Abigail Olaleye[2], Samantha Moore[2] & Stanton Newman[2]

[1] School of Health Sciences, City, University of London, London, UK
[3] Department of Rheumatology, University College London Hospital, London, UK

* Hayley McBain and Chris Flood contributed equally to this paper

Corresponding author: Dr Hayley McBain, City, University of London Northampton Square, London, EC1V 0HB. United Kingdom Email: hayley.mcbain.1@city.ac.uk, Tel: 00 44 207 040 0870.

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ABSTRACT

Objective To determine whether a patient-initiated DMARD self-monitoring service for people on methotrexate is a cost-effective model of care for patients with rheumatoid (RA) or psoriatic arthritis (PsA).

Methods An economic evaluation from a societal perspective was undertaken alongside a randomised controlled trial involving 100 patients. Outcome measures were quality of life and ESR assessed at baseline and post intervention. Costs were calculated for healthcare usage using a UK NHS economic perspective. Sensitivity analysis was performed to explore the impact of nurse-led telephone helplines. Uncertainty around the cost-effectiveness ratios was estimated by bootstrapping and analysing the cost-effectiveness planes.

Results 52 patients received the intervention and 48 usual care. The difference in mean cost per case indicated that the intervention was £263 more expensive (95% CI -£447 to -£78) when the helpline costs were accounted for and £94 cheaper (95% CI -£75 to £264) when these costs were absorbed by the usual service. When costs and effects were combined this did not show the patient-initiated service to be cost-effective at a statistically significant level.

Conclusions This patient-initiated service led to clear reductions in primary and secondary healthcare services, which translated into reduced costs in comparison to usual care but were not cost-effective. Further work is needed to establish how nurse-led telephone triage services are integrated into rheumatology services and the associated costs of setting up and delivering them in order to establish the true cost-effectiveness of patient-initiated models of care.

Keywords rheumatoid arthritis, psoriatic arthritis, self-care, randomized controlled trial, patient-initiated

INTRODUCTION

The increasing complexity of drug treatments and more intensive monitoring regimes have, in part, led to a huge growth in the numbers of patients with arthritis in follow-up clinics.[1] The birth of the rheumatology nurse specialist and nurse-led care reduced some of this demand and is equally as effective and cost-effective as rheumatologist-led care.[2-3] Despite this, the monitoring requirements remain burdensome for both the health system and patients, with increased waiting times for new referrals and lack of availability of urgent appointments for established patients. In the UK[4] two-thirds of healthcare trusts were unable to offer rheumatoid arthritis patients a timely follow-up appointment. Even when these appointments do occur, 30% lead to no investigation or other actions, 35% are seen to be problem free by rheumatologists and 42% completely unnecessary.[5] As a result, the focus is now on reducing unnecessary outpatient and follow-up appointments altogether, rather than simply redirecting care.[6]

One way in which this could be achieved is through the use of patient-initiated services, in which patients are encouraged to take an active role in initiating their own care. This approach is supported by over 40% of patients with arthritis who feel they should be able to decide how frequently they need a check-up[7] and want to take responsibility for organising their own DMARD monitoring appointments.[8] Whilst the traditional rheumatology system assumes that patients need to be seen on a regular basis, as decided by clinicians, patient-initiated services allow the patient to access rheumatology services much like they do in primary care. A recent systematic review[9] concluded that UK policy is eager for evidence-based patient-initiated services to be implemented and evaluated

qualitatively and quantitatively so that the time of both patients and healthcare professionals is not wasted and costs can be minimised. The trials reported within this systematic review[10-13] and subsequent evaluations[14-21] have found that patients with arthritis are able to appropriately self-refer, and that despite reducing hospital appointments, the clinical and psychological well-being of patients is not compromised.

The findings in relation to the costs of this model of care are however less clear, with costs in primary care potentially increasing, but decreasing in secondary care.[9] The only trial in rheumatology to estimate the costs of a patient-initiated service[10] found that the intervention significantly reduced costs to the NHS over one year (£208 per patient per year) in comparison to usual follow up (£313 per patient per year). The study however, failed to account for the costs of running the nurse helpline, an integral part of any patient-initiated service, and compare these with the relative effects.

The aim of this study is therefore to determine whether a patient-initiated DMARD self-monitoring follow-up service, which has been found to effective in reducing resources without comprising clinical or psychological well-being,[21] is cost-effective in comparison to treatment as usual.

METHODS

Study design

An economic evaluation was undertaken alongside a two-arm, single centre, randomised controlled trial (RCT) comparing a patient-initiated DMARD self-monitoring service with usual care. The design of this trial has been described in detail elsewhere.[21] The study was

approved by Camden and Islington Community Local Research Ethics Committee (Ref. 09/H0722/91) and all participants provided written informed consent.

Study population

Participants were recruited from the Department of Rheumatology at University College Hospital NHS Foundation Trust, UK. Inclusion criteria were stable patients diagnosed with either RA[22] or PsA[23]. Stable treatment was defined as methotrexate for at least 6 months, plus a further 3 months if the patient were receiving either adalimumab or etanercept. Exclusion criteria were patients whose predominant treatment was for another illness, those for whom blood tests and monitoring was undertaken by their GP and patients prescribed infliximab.

Intervention

Participants randomised to the self-monitoring service took part in a group-based training session to provide them with the knowledge, skills and resources required to self-monitor and initiate care. This one-off 2-hour training session was delivered by a rheumatologist and a health psychologist, to groups of 2-6 participants who were taught how to identify normal or “safe” ranges of blood levels, side effects and symptoms, decide if any action was necessary, and to initiate care from their rheumatology nurse specialist. Participants were guided through example blood test scenarios and given practice materials to be completed during the session. The results of these tasks were then reviewed during group discussions led by the rheumatologist. Participants continued to receive routine care from their rheumatologist, had access to the emergency nurse helpline if necessary and continued with routine blood monitoring.

Following each blood test, participants were sent a copy of their results either via email or post, depending on the patient's preference. Criteria for a significant change or out-of-range blood test were developed and agreed by the clinical team and shared with the patient. Participants also recorded, using a 17-item checklist, the side effects and symptoms they had experienced since their last blood test, indicating if they were any new or continuing symptoms. For continuing symptoms participants indicated if the symptom had become worse, better or remained the same since their last blood test.

Control group

Participants in the control group received standard care; this typically consisted of blood tests every 4-6 weeks and optimally outpatient appointments with their nurse specialist every 3 months and rheumatologist every 6 months.

Outcome measures

The current study analysed cost-effectiveness by calculating the incremental cost-effectiveness ratio, defined as the between trial arm differences in costs divided by the difference in effects. Disease activity was measured using ESR and quality of life using the SF-12v1 [24] across two component summary scales - the Physical (SF-12v1® PCS) and Mental Component Summary (SF-12v1® MCS). Total scores range from 0-100 with higher scores representing better quality of life. The scale is responsive to change and has good test retest reliability.[24]

Perspectives and costs

A UK NHS economic perspective was adopted, including costs to the individual. Healthcare costs were outpatient visits in secondary care, and visits to primary care services, blood tests, medication and the costs of running the nurse telephone helpline, plus for the

intervention arm the cost of delivering the education. Individual costs to the patient included travel to and from the hospital.

Discounting

National pricing and reimbursement agencies generally recommend discounting of costs and effects at 3% annually. Due to our short follow-up, data are presented undiscounted.

Statistical methods

Unit costs were applied to individual service use data and costs per participant were identified and totalled for total costs between trial arms, using Excel software. Further cost-effectiveness analyses were performed to calculate incremental cost-effectiveness ratios (ICERs), which measure the difference in average costs between the two trial arms divided by the difference in average effects to a create point estimate. A new model of care would be 'dominated' by existing services if it costs more, but provides less quality of life 'gain'. Whilst useful for establishing a point estimate and an initial sense of the data ICERs can be easily misinterpreted. For example, an intervention that is less expensive and more effective will generate a negative ICER, but so will an intervention that is more expensive and less effective. Whilst therefore the point estimates of the mean differences in trial arms between the effects and costs in the ICER provides a best estimate, and it is correct to refer to them in the primary analysis, the interpretation of negative ICERs are problematic due to the ratio statistic nature of the ICER and the production of confidence intervals.[25] One of the proposed solutions to the problem of estimating confidence limits for the ICER is therefore the use of the nonparametric approach of bootstrapping,[26] a technique that helps to produce cost effectiveness acceptability curves (CEAC), which provides a way of presenting results without having to report negative ICER values.[27]

In this study, we used repeat re-sampling from the costs and effectiveness data using non-parametric bootstrapping to generate a distribution of mean costs and effects for the two study arms. Statistical sensitivity analysis was conducted by estimation of confidence intervals for mean difference in costs and effects per participant, and by plotting CEACs. Cost-effectiveness acceptability curves allow decision makers to assess the overall probability of cost-effectiveness given particular thresholds. This has then the potential to show whether a patient initiated self-monitoring service can be cost-effective compared with standard care for a range of maximum monetary values (ceiling ratios, λ) that a decision maker might be willing to pay for any gain in quality of life or disease activity. Acceptability curves also illustrate the uncertainty associated with the estimate of costs and effects as a result of sampling variation and were developed as a way of overcoming the previously described statistical difficulties of calculating confidence intervals around incremental cost effectiveness ratios.

This was repeated using three different measures of effectiveness: a change in quality of life based on the PCS and MSC of the SF-12v1®, as well as a change in ESR. To capture any improvement in inflammation whereby a lower score is desirable we reversed scored the ESR change scores (change from baseline to follow-up). For example, where a baseline score moved from 20 to 4 rather than depict this as -16, this was simply reversed to read as 16, denoting improvement.

We performed several sensitivity analyses to ascertain thresholds for cost-effectiveness and to explore the robustness of results in relation to changes in the cost data. This included performing analysis for two different models of care:

- **Model One:** The intervention and control group as implemented including telephone calls to the rheumatology nurse specialist helpline.
- **Model Two:** The intervention and control group as implemented not including the costs associated with the nurse helpline - replicating the analysis performed elsewhere in the literature.[8] This model assumes that the additional telephone contact generated by the intervention could be managed by the existing rheumatology nurse specialists.

Each of these models was costed using the national average unit cost, as well as the upper and lower quartiles.[28-30] As part of the sensitivity analysis, the analysis of cost effectiveness was conducted with all three estimates (involving an upper, average and lower cost to assess whether cost effectiveness was sensitive to these). No differences were found between these three levels and hence the results reported are for the average costs.

RESULTS

Full details on the participant characteristics and clinical outcomes are presented elsewhere.[21] The mean quality of life and ESR gains post intervention, and for the control group can be found in Table 1 and indicate no statistically significant changes within or between trial arms.

Table 1 Mean change in effect

	ESR	SF-12v1 MCS	SF-12v1 PCS
Intervention	0.92	0.61	-1.09
Control	-0.71	-1.02	1.43
Mean difference (95% CI)	1.63 (-2.98 to 6.24)	1.63 (-0.76 to 4.02)	-2.52 (-5.55 to 0.51)

MSC – mental health component score; PCS – physical health component score

Resources use and cost outcomes

The cost data is presented in Table **1**. It shows the costs per participant divided into public sector costs and those borne by the participant. Public sector costs are further subdivided by providing authority. Mean total costs of care per intervention participant over the trial period were £1029 including the nurse-led telephone helpline (model 1) and £672 excluding the helpline (model 2). Mean total costs of care per control participant over the trial period were £766. The difference in mean cost per case indicated that the intervention was £263 more expensive (95% CI -£447 to -£78) when the helpline costs were accounted for and £94 cheaper (95% CI -£75 to £264) when these costs were absorbed by the usual service. The wide confidence intervals reflect high variability in costs between trial participants.

Although not statistically significant the cost of primary care was higher in the control compared to intervention arm by £17 (95% CI -£13 to £46). Secondary care costs represented the majority of the overall costs in both arms and across both models. The overall costs of delivering secondary care services was higher in the intervention compared to control group by £295 (95% CI -£452 to -£138) when the helpline costs were included and £62 cheaper (95% CI -£78 to £201) when they were not. The cost of face-to-face appointments with the clinical nurse specialist were significantly ($p < 0.001$) higher in the control arm by £71 (95% CI £19 to £123). For advice given via the nurse telephone helpline there were no costs for the control arm, mean costs for the intervention arm were £357. The mean difference in costs to the individual between arms was £16 more in the control group (95% CI -£5 to £37) as a consequence of having to travel to the clinic.

Table 1 **Costs of services to participants in the trial (cost per patient by treatment arm in £ Sterling)**

Detail of costs	Intervention arm n=52			Control arm n=48			Mean difference (Intervention - Control)	(95%CI)		*p*
	Mean	SD	Total cost %	Mean	SD	Total cost %				
Primary care										
General practitioner	22.03	34.47	3.28	38.68	53.73	5.05	16.65	-12.62	45.91	0.32
Total primary care costs	**22.03**	**34.47**	**3.28**	**38.68**	**53.73**	**5.05**	**16.65**	**-12.62**	**45.91**	**0.32**
Secondary care										
Rheumatologist	245.54	132.70	23.78	285.40	210.72	37.08	39.86	-74.32	154.04	0.86
CNS (face-to-face)	51.35	71.26	4.97	122.38	89.24	15.90	71.03	18.82	123.24	<0.001
CNS (telephone)	356.92	110.29	34.57	0.00	0.00	0.00	-356.92	-406.51	-307.33	<0.001
Full blood count	59.40	13.55	5.75	57.68	11.04	7.49	-1.72	-9.67	6.22	0.62
ALT & ALP	41.75	9.52	4.04	40.54	7.76	5.27	-1.21	-6.79	4.37	0.62
ESR	41.75	9.52	4.04	40.54	7.76	5.27	-1.21	-6.79	4.37	0.62
CRP	41.75	9.52	4.04	40.54	7.76	5.27	-1.21	-6.79	4.37	0.62
Education	41.70	0.00	4.04	0.00	0.00	0.00	-41.70	-41.70	-41.70	<0.001
Methotrexate	47.04	14.66	4.57	44.99	15.00	5.87	-2.05	-11.61	7.52	0.32
Total secondary care costs (model 1)	**927.18**	**249.18**	**90.12**	**632.04**	**238.29**	**82.48**	**-295.13**	**-452.21**	**-138.06**	**<0.001**
Total secondary care costs (model 2)†	**570.25**	**190.86**	**84.88**	**632.04**	**238.29**	**82.48**	**61.79**	**-77.79**	**201.37**	**0.75**
Total cost to health service (model 1)	**949.20**	**250.25**	**92.26**	**670.72**	**262.62**	**87.53**	**-278.49**	**-113.01**	**-443.96**	**<0.001**
Total cost to health service (model 2)†	**592.28**	**193.99**	**88.16**	**670.72**	**262.62**	**87.53**	**78.44**	**-70.99**	**227.86**	**0.61**
Individual										
Travel to outpatients	43.62	26.03	6.49	63.38	31.94	8.27	19.76	0.92	38.59	0.06
Travel to other services	35.96	9.29	5.35	32.19	10.41	4.20	-3.77	-10.14	2.60	0.14
Total cost to individual	**79.58**	**26.32**	**12.74**	**95.56**	**37.53**	**13.25**	**15.99**	**-5.01**	**36.98**	**0.21**

Total cost per case (model 1)	**1028.78**	**272.13**	**100.00**	**766.28**	**299.13**	**100.00**	**-262.50**	**-447.08**	**-77.92**	**<0.001**
Total cost per case (model 2)†	**671.86**	**218.31**	**100.00**	**766.28**	**299.13**	**100.00**	**94.42**	**-75.08**	**263.93**	**0.54**

† model 2 - excluding telephone helpline

Cost effectiveness analysis

ESR

The ICER for utility based on an improvement change in ESR was £161 when the helpline costs were included and -£58 when they were not. The cost-effectiveness plane in 11 shows a distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in ESR to determine utility scores. For both models the replicates were distributed across all four quadrants. In model 2, when helpline costs are not accounted for the replicates appeared more in the southern quadrants.

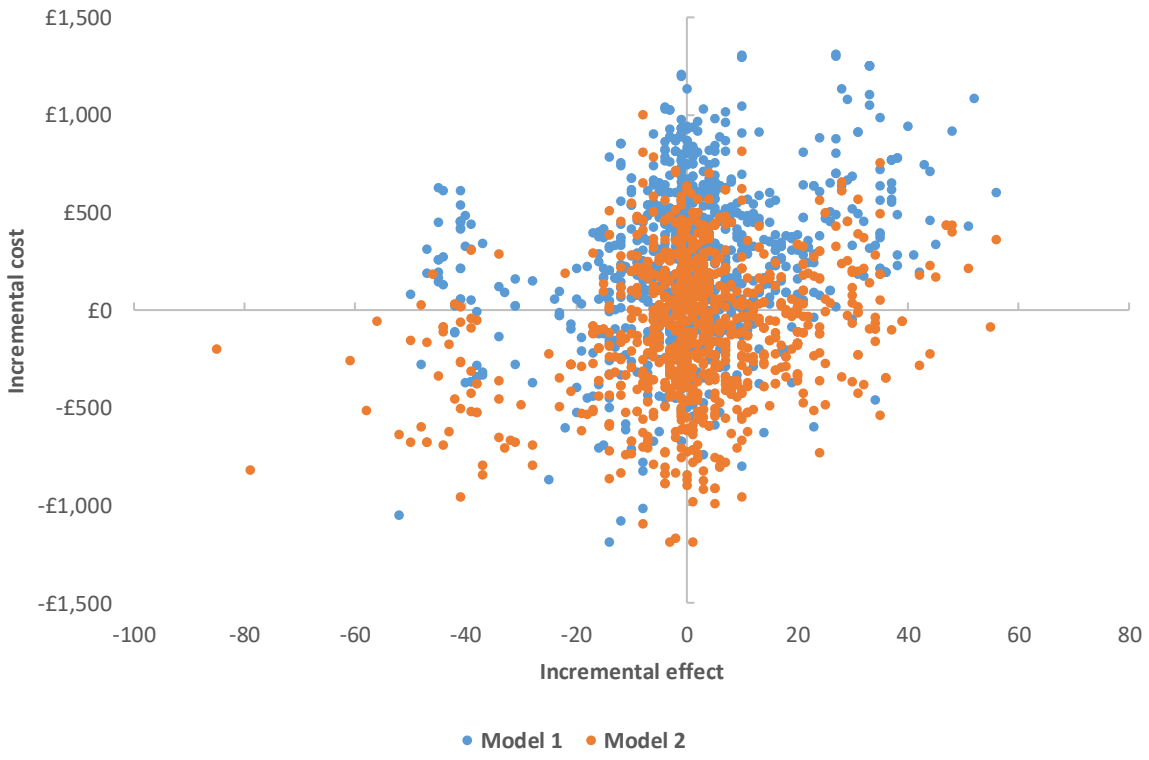

Figure 1 Cost effectiveness plane showing distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in ESR for model 1 (helpline costs included) and model 2 (helpline costs not included)

Cost-effectiveness acceptability curves for both models are shown in Figure 2. The analysis based on a cost per unit of change in ESR indicates that the probability of a cost-

effectiveness was no more than 57% when helpline costs are accounted for (model 1) and 58% when they are not (model 2), at different thresholds of expenditure from £1000 up to £50,000.

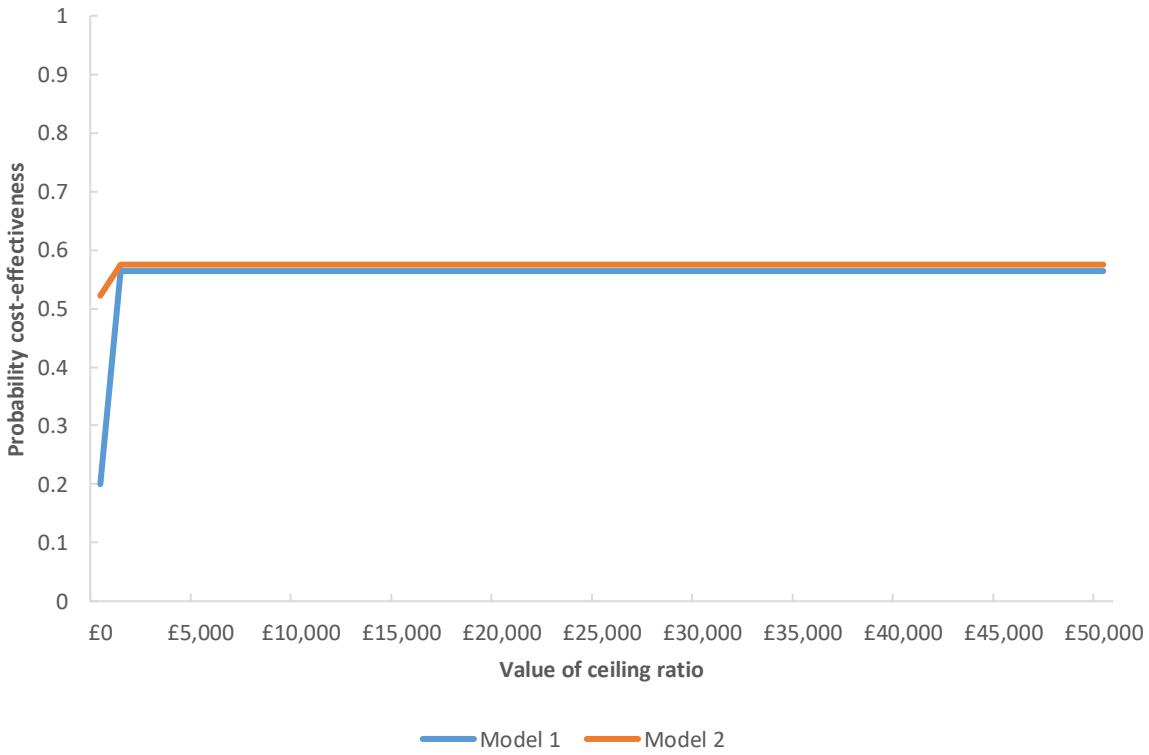

Figure 2 CEA curve for the new service and care as usual using a change in ESR for model 1 (helpline costs included) and model 2 (helpline costs not included)

Mental health quality of life

The ICER for utility based on an improvement change in mental health quality of life was £161 for model 1 and -£58 for model 2. The cost effectiveness plane in 1 shows that for both models the replicates were distributed across all four quadrants. In model 2 the replicates appeared more in the southern quadrants.

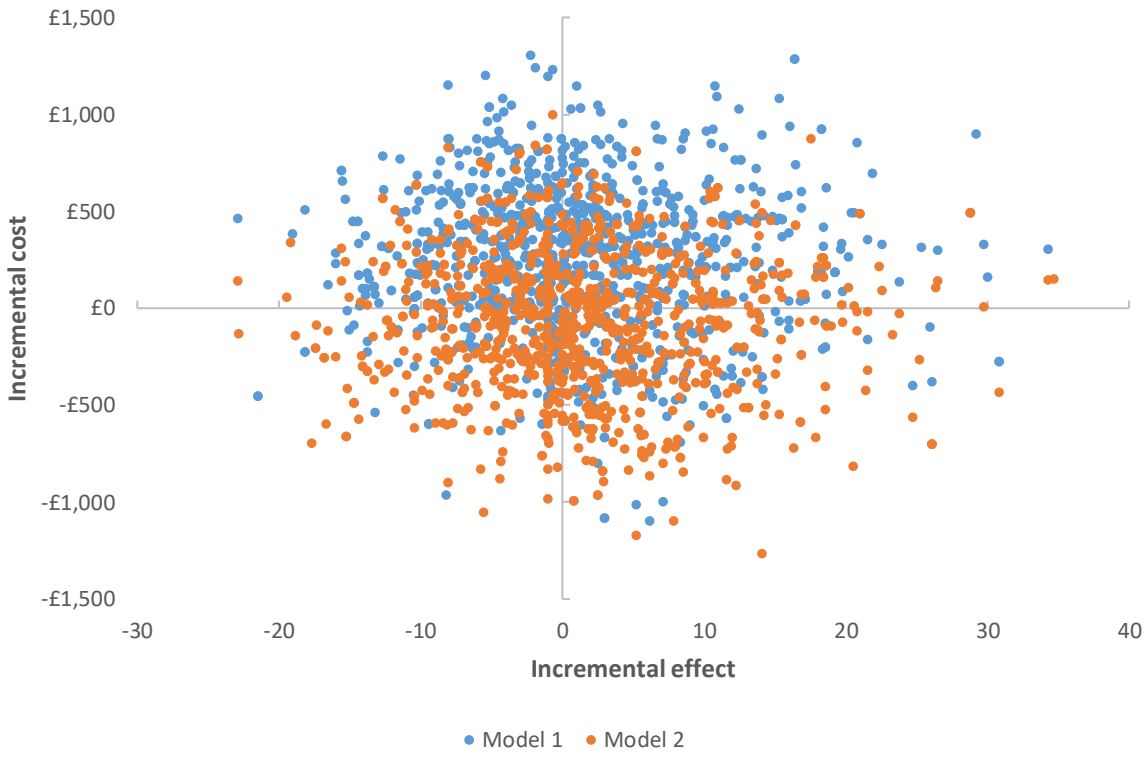

Figure 1 Cost effectiveness plane showing distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in mental health quality of life for model 1 (helpline costs included) and model 2 (helpline costs not included)

Cost-effectiveness acceptability curves are shown in Figure 4. The analysis based on a cost per unit of change in mental health-related quality of life suggests that the probability of cost-effectiveness was no more than 53% for model 1 and 55% for model 2.

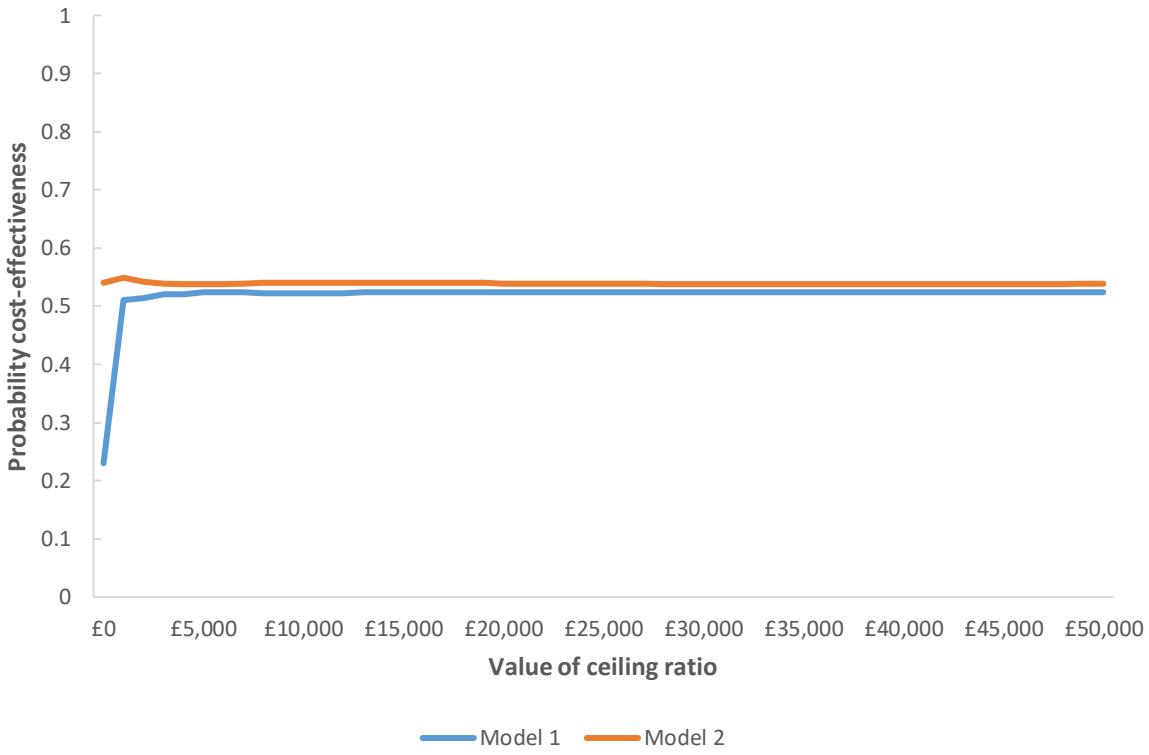

Figure 4 CEA curve for the new service and care as usual using a change in SF-12v1 MCS for model 1 (helpline costs included) and model 2 (helpline costs not included)

Physical health quality of life

The ICER for utility based on an improvement change in physical health-related quality of life was -£104 for model 1 and £37 for model 2. The cost effectiveness plane in Figure 5 shows that for both models the replicates were distributed across all four quadrants. In model 2, when the costs of the helpline are not included the replicates appeared more in the southern quadrants.

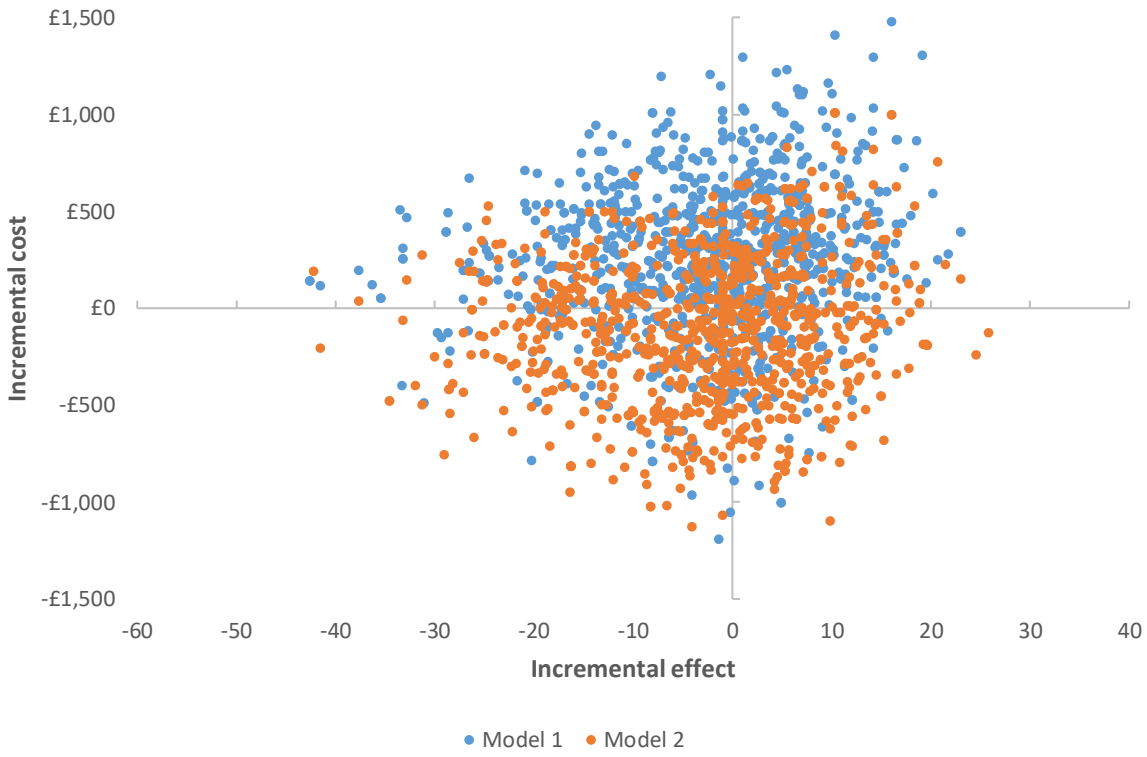

Figure 5 Cost effectiveness plane showing distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in physical health quality of life for model 1 (helpline costs included) and model 2 (helpline costs not included)

Cost-effectiveness acceptability curves are shown in Figure 6. The analysis based on a cost per unit of change in physical health-related quality of life show that the probability of cost-effectiveness was no more than 45% for model 1 and 60% for model 2.

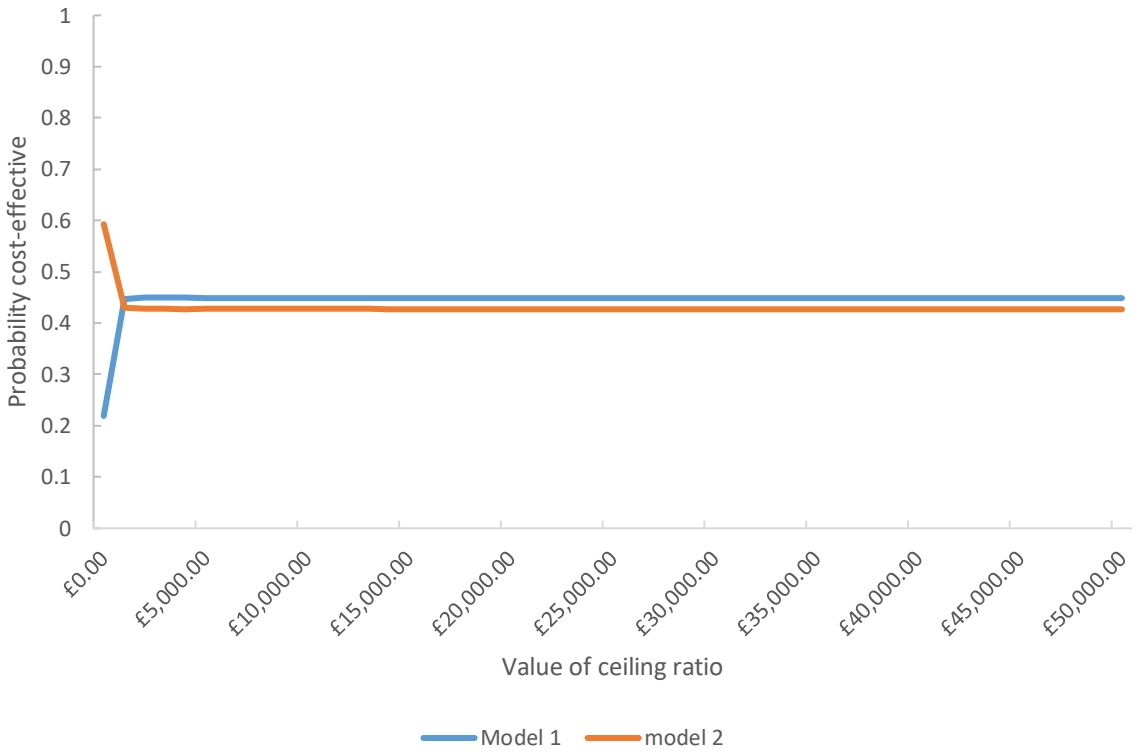

Figure 6 CEA curve for the new service and care as usual using a change in SF-12v PCS for model 1 (helpline costs included) and model 2 (helpline costs not included)

DISCUSSION

To the author's knowledge, this is the first cost-effectiveness analysis of a patient-initiated service that uses CEACs for assessing uncertainty around the distribution of costs and variability of costs, as recommended in the literature.[31] The primary findings of the RCT indicated that this alternative model of care led to reductions in the use of primary and secondary care services, and was not inferior to standard practices in regard to disease activity, pain, fatigue, quality of life or mood.[21] The aims of this study were to therefore establish whether these reductions in healthcare usage translated into cost savings and being cost-effective.

The analysis indicates that there were no significant differences between standard care and the patient-initiated service in the costs related to specialist consultations with the rheumatologist or GP visits. The cost of outpatient visits to the nurse specialist were however, significantly lower in the patient-initiated service compared to standard care. This meant that costs borne by primary and secondary care service were lower for the intervention arm compared to control conditions, although not significantly different. This is in line with a systematic review of patient-initiated services across a range of chronic or recurrent conditions managed in secondary care,[9] in which the intervention was not harmful to patients but was associated with savings in health service resources and costs.

When the overall costs to the patient and primary and secondary care were combined the patient-initiated service was £94.42 cheaper to run per patient than control conditions. Although this was not statistically significant this equates to a saving of £42,489 across the 450 eligible patients at UCLH if rolled out across the service. This model however, assumes that the activity generated on the telephone triage service could be absorbed into the current service. Akin to a previous trial evaluating patient-initiated follow-ups in RA,[10] which concluded that fewer resources were associated with the intervention. This model however fails to account for the costs associated with a telephone triage service. When these costs are taken into account, rather than absorbed into the current service, the cost per participant in the intervention arm of this trial increased significantly to £1028.78, £262.50 more expensive than usual care which made the patient-initiated service significantly more expensive at £118,125 if rolled out across the service. It is however important to note that a number of the telephone calls made by intervention participants to the triage service were not deemed necessary as blood test results were within range, had

not changed significantly or the patient had no new or worsening symptoms. With additional training and time these unnecessary telephone calls could be reduced significantly.

Telephone triage services are a key component of most patient-initiated services.[9] The costs of delivering this service in the year the trial was initiated[28-30] have since reduced[32] narrowing the potential difference in costs associated with delivering the intervention compared to usual care, but are still substantial. Despite The Royal College of Nursing recommending that telephone advice lines should be assessed for cost-effectiveness[33] very few studies have explored this. When estimating the savings made in primary care by introducing a rheumatology nurse helpline, 60% of patients have stated that they would have consulted their GP had the helpline not been available, which has been translated into a potential cost saving of £4303 a year.[34] Although visits to the GP were lower in the intervention arm in the current trial[21] this did not outweigh the costs of delivering the nurse helpline. Nurse-led helplines have also been criticized for being overly time-consuming[35] particularly in situations where it is offered as an additional clinical service and not treated as a core activity. Further research needs to be conducted to establish how these services are resourced, the costs of setting up and delivering them and their cost-effectiveness especially if they were incorporated into core services where economies of scale might pertain.

Going beyond a description of the resources used and the mean difference in costs between the trial arms and unlike the trials reported in a previous systematic review,[9] this study explored the uncertainty around the distribution of costs and variability of costs using

CEACs. When costs and effects were combined this did not show the patient-initiated service to be cost-effective at a statistically significant level. Nonetheless it would be wrong to simply interpret the findings as negative. The probability of the service being cost-effective ranged from 45 to 60%, with in most cases it being more likely to be cost effective when the helpline costs were absorbed within the current service. In addition limitations of this trial meant that data were not available on the number of telephone calls made by the control group to the nurse helpline. Nor was data collected in either groups on use of other services such as physiotherapy, occupational therapy or podiatry. Together this data has the potential to increase the cost of usual care.

Methodologically, due to the lack of allocation concealment and blinding the effects of the service may have been biased.[36-37] Finally, the single centre status of the trial has reduced the external validity of the findings,[38] and may have led to larger intervention effects on both the continuous [39] and binary outcomes.[40] A larger multi-centre RCT would therefore be required.

This patient-initiated service led to clear reductions in primary and secondary healthcare services, which translated into reduced costs in comparison to usual care. When these figures were combined with disease activity and quality of life changes however, the cost-effectiveness analyses were not statistically significant. Further work around the integration and costs of delivering nurse-led telephone triage services in rheumatology care is needed in order to establish the true cost-effectiveness of such services.

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CONTRIBUTORS: SN and MS conceived the original idea and put the study team together. SN provided expertise in patient self-management, supervised the design and conduct of the trial, the study evaluation and reviewed the analyses by contributing towards the interpretation of the study findings. MS contributed to study design, co-delivered the intervention, and provided rheumatology expertise. HM led on the design and delivery of the trial, co-led the analyses and reporting, and drafted the manuscript. AO and SM provided clinical expertise, assisted in the identification and recruitment of participants, and delivery of the intervention. CF co-led the analysis and reporting. All authors contributed to, reviewed and approved the final manuscript.

ETHICAL APPROVAL: This study was conducted with approval from Camden and Islington Community Local Research Ethics Committee (Ref. 09/H0722/91).

PROVENANCE AND PEER REVIEW: Not commissioned; externally peer reviewed.

REFERENCES

1. Kvalvik AG, Larsen S, Aadland HA et al. Changing structure and resources in a rheumatology combined unit during 1977-1999. *Scand J Rheumatol* 2007;36,125-35.
2. Ndosi M, Lewis M, Hale C et al. The outcome and cost-effectiveness of nurse-led care in people with rheumatoid arthritis: a multicentre randomised controlled trial. *Ann Rheum Dis* 2013;73:1975-82.
3. Ndosi M, Vinall K, Hale C et al. The effectiveness of nurse-led care in people with rheumatoid arthritis: A systematic review. *Int J Nurs Stud* 2011;48:642-54.
4. National Audit Office. Services for people with rheumatoid arthirtis: census findings. London: The Stationart 2009.
5. Hehir M, Mitchell K, Hewlett S et al. What happens in rheumatoid arthritis out-patient clinics? *Rheumatology (Oxford)* 2001;40:146.
6. NHS. The NHS Long Term Plan version 1.1. https://www.longtermplan.nhs.uk/.
7. Neame R, Hammond A and Deighton C. Need for information and for involvement in decision making among patients with rheumatoid arthritis: a questionnaire survey. *Arthritis Rheum* 2005;53:249-55.
8. Kay LJ and Lapworth K. Safety monitoring for disease-modifying anti-rheumatic drugs in primary and secondary care: Adherence to local and national guidelines and patient's views. *Rheumatology (Oxford)* 2004;43:105.
9. Whear R, Abdul-Rahman AK, Boddy K et al. The Clinical Effectiveness of Patient Initiated Clinics for Patients with Chronic or Recurrent Conditions Managed in Secondary Care: A Systematic Review. *PloS one* 2013;8:e74774.

10. Hewlett S, Mitchell K, Haynes J et al. Patient-initiated hospital follow-up for rheumatoid arthritis. *Rheumatology (Oxford)* 2000;39:990-7.
11. Hewlett S, Kirwan J, Pollock J et al. Patient initiated outpatient follow up in rheumatoid arthritis: six year randomised controlled trial. *BMJ* 2005;330:171.
12. Kirwan JR, Mitchell K, Hewlett S et al. Clinical and psychological outcome from a randomized controlled trial of patient-initiated direct-access hospital follow-up for rheumatoid arthritis extended to 4 years. *Rheumatology (Oxford)* 2003;42:422-6.
13. Chattopadhyay C and Hickey P. Are Routine Appointments Cost-Effective in Modern Rheumatology Practice? A Comparative Outcome Audit of Routine Follow-ups and Patient Initiated Consultations. American College of Rheumatology 2008 Annual Scientific Meeting 2008;1957.
14. Primdahl J, Sørensen J, Horn HC et al. Shared care or nursing consultations as an alternative to rheumatologist follow-up for rheumatoid arthritis outpatients with low disease activity - patient outcomes from a 2-year, randomised controlled trial. *Ann Rheum Dis* 2014;73:357-64.
15. Primdahl J, Wagner L, Holst R et al. The impact on self-efficacy of different types of follow-up care and disease status in patients with rheumatoid arthritis - A randomized trial. *Patient Educ Couns* 2012;88:121-8.
16. Sands A and Adams N. A comparison of patient-initiated versus conventional follow-up for rheumatoid arthritis. *Rheumatology (Oxford)* 2009;48:i157-8.
17. Adams N and Sands A. Patient versus practitioner-initiated follow-up for rheumatoid arthritis. *Eur J Pain* 2009;13:S132.
18. Symmons D, Tricker K, Roberts C et al. The British Rheumatoid Outcome Study Group (BROSG) randomised controlled trial to compare the effectiveness and cost-

effectiveness of aggressive versus symptomatic therapy in established rheumatoid arthritis. *Health Technol Assess* 2005;9:iii-iiv.

19. Symmons D, Tricker K, Harrison M et al. Patients with stable long-standing rheumatoid arthritis continue to deteriorate despite intensified treatment with traditional disease modifying anti-rheumatic drugs - results of the British Rheumatoid Outcome Study Group randomized controlled clinical trial. *Rheumatology (Oxford)* 2006;45:558-65.
20. Goh L, Samanta J, and Samanta A. Rheumatology nurse practitioners' perceptions of their role. *Musculoskeletal Care* 2006;4:88-100.
21. McBain H, Shipley M, Olaleye A et al. A patient-initiated DMARD self-monitoring service for people with rheumatoid or psoriatic arthritis on methotrexate: a randomised controlled trial. *Ann Rheum Dis* 2016;75:1343-9.
22. Aletaha D, Neogi T, Silman AJ et al. 2010 Rheumatoid arthritis classification criteria: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Ann Rheum Dis* 2010;69:1580-88. .
23. Taylor W, Gladman D, Helliwell P et al. Classification criteria for psoriatic arthritis: Development of new criteria from a large international study. *Arthritis Rheum* 2006;54:2665-73.
24. Ware Jr JE, Kosinski M, and Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34:220-33.
25. Briggs AH, O'Brien BJ, and Blackhouse G. Thinking Outside the Box: Recent Advances in the Analysis and Presentation of Uncertainty in Cost-Effectiveness Studies. *Annual Review of Public Health* 2002;23:377-401.

26. Efron B, Tibshirani R. An Introduction to the Bootstrap. 1993. New York: Chapman & Hall.

27. Tan MC, Regier DA, Esdaile JM et al. Health economic evaluation: A primer for the practicing rheumatologist. *Arthritis Rheum* 2006;55;648-56.

28. Department of Health. (2011). 2010-11 reference costs publication. Retrieved from Department of Health https://www.gov.uk/government/publications/2010-11-reference-costs-publication. Accessed 04.04.18.

29. Department of Health. (2013). Department of Health Reference costs for 2012-13. Retrieved from https://www.gov.uk/government/publications/nhs-reference-costs-2012-to-2013. Accessed 04.04.18.

30. Curtis, L. (2012). Unit costs of Health and Social Care 2012. Canterbury: Personal Social Services Research Unit.

31. Ramsey S, Willke R, Briggs A, Brown R, Buxton M, Chawla A, Cook J, Glick H, Liljas B, Petitti D, Reed S. Good research practices for cost-effectiveness analysis alongside clinical trials: the ISPOR RCT-CEA task force report. *Value in health* 2005;8:521-33.

32. Department of Health. (2016). Department of Health Reference costs for 2016-17. Retrieved from https://improvement.nhs.uk/documents/1973/2_-_National_schedule_of_reference_costs_-_the_main_schedule.xlsx. Accessed 04.04.18.

33. The Royal College of Nursing. (2012). Using telephone advice for patients with long-term conditions: an RCN guide to using technology to complement nursing practice. London, Royal College of Nursing.

34. Hughes RA, Carr ME, Huggett A. Review of the function of a telephone helpline in the treatment of outpatients with rheumatoid arthritis. *Ann Rheum Dis* 2002;61:341-345.
35. Dale J, Crouch R. It's good to talk. *Health Serv J* 1997;16:24–6.
36. Moher D, Pham B, Jones A et al. Does quality of reports of randomised trials affect estimates of intervention efficacy reported in meta-analyses? *Lancet* 1998;352:609-13.
37. Pildal J, Hrobjartsson A, Jörgensen KJ et al. Impact of allocation concealment on conclusions drawn from meta-analyses of randomized trials. *Int J Epidemiol* 2007;36:847-57.
38. Bellomo R, Warrillow SJ, and Reade MC. Why we should be wary of single-center trials. *Crit Care Med* 2009;37:3114-9.
39. Bafeta A, Dechartres A, Trinquart L et al. Impact of single centre status on estimates of intervention effects in trials with continuous outcomes: meta-epidemiological study. *BMJ* 2012;344:e813.
40. Dechartres A, Boutron I, Trinquart L et al. Single-center trials show larger treatment effects than multicenter trials: evidence from a meta-epidemiologic study. Ann *Intern Med* 2011;155:39-51.

Figure 1. Cost effectiveness plane showing distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in ESR for model 1 (helpline costs included) and model 2 (helpline costs not included)

Figure 2. CEA curve for the new service and care as usual using a change in ESR for model 1 (helpline costs included) and model 2 (helpline costs not included)

Figure 2. Cost effectiveness plane showing distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in mental health quality of life for model 1 (helpline costs included) and model 2 (helpline costs not included)

Figure 4. CEA curve for the new service and care as usual using a change in SF-12v1 MCS for model 1 (helpline costs included) and model 2 (helpline costs not included)

Figure 5. Cost effectiveness plane showing distribution of 1000 replicates of cost and effects for the new service and care as usual using a change in physical health quality of life for model 1 (helpline costs included) and model 2 (helpline costs not included)

Figure 6. CEA curve for the new service and care as usual using a change in SF-12v PCS for model 1 (helpline costs included) and model 2 (helpline costs not included)