Increasing heart-health lifestyles in deprived communities: economic evaluation of lay health trainers

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Abstract
Rationale, aims and objectives Cardiovascular disease (CVD) often arises from modifiable lifestyle factors. Health care professionals may lack the skills and resources to sustain behaviour change, lay ‘health trainers’ (LHT) offer a potential alternative. We sought to assess the cost-effectiveness of using a LHT to improve heart-health lifestyles in deprived communities.

Methods Participants in this randomized trial were aged ≥18 years with at least one risk factor for CVD (hypertension, raised cholesterol, diabetes, BMI>30 or current smoker). Both groups received health promotion literature. LHT were also able to provide intervention participants with information, advice and support aimed at changing beliefs and behaviour. Costs and quality-adjusted life year (QALY) changes were estimated over 6 months. The cost-utility [incremental cost-effectiveness ratio (ICER)] of LHT was calculated and assessed in relation to the cost-effectiveness threshold of £20 000–30 000 per QALY. The probability of LHT being cost-effective was also calculated.

Results Seventy-two participants were randomized to a LHT, with 38 controls. The mean cost of the LHT intervention was £151. On average, other health and social service costs fell by £21 for controls and £75 for intervention participants giving a LHT mean overall incremental cost of £98. The mean QALY gains were 0.022 and 0.028, respectively. The ICER for LHT was £14 480, yet there was a 61% chance of making the wrong decision at a £20 000/QALY threshold.

Conclusion LHT provision was estimated to be cost-effective for people at risk of CVD. However, a large level of uncertainty was associated with that decision.

Introduction
Cardiovascular disease (CVD) is one of the main causes of death, reducing CVD rates is therefore a key government target [1]. Ninety per cent of CVD cases are associated with modifiable lifestyle factors – smoking, high saturated fat diet, low consumption of fruit and vegetables, hypertension (diet related) and lack of physical activity [2]. Prevalence is greatest in deprived communities [3]. UK governments have outlined the importance of reducing these health inequalities [4], promoting heart-health lifestyles (e.g. reducing smoking [5], increasing physical activity [6], and intake of fruit and vegetables [7]) and giving individuals and communities greater control over health [8].

Practical advice and support has been shown to produce sustained behaviour change [9]. Lifestyle changes have also reduced CVD risk [10]. However, health care professionals often lack the skills and resources to promote sustained behaviour change [11].

Lay health trainers (LHTs), who work with individuals in the community to support the adoption of healthy behaviours, have been introduced in many settings [12], and could represent a viable alternative because increasing heart-health lifestyle behaviours may require work outside the traditional medical approach [13]. With regard to CVD, a review concluded that LHT interventions result in positive outcomes, but that little was known about their resource impact [12]. Here we estimate the resource use, and level of cost-effectiveness, associated with a LHT intervention which aimed to increase heart-health lifestyles.

Methods

Participants Five GP practices serving deprived communities [14] within Liverpool Primary Care Trust identified adults aged ≥18 years...
with at least one of five CVD risk factors: hypertension [systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg [15]], raised total cholesterol (≥ 5.2 mmol L$^{-1}$ [16]), diabetes, BMI > 30.0 kg m$^{-2}$ or current smoker. Those with established CVD, a prescribed diet that may conflict heart-health dietary advice, little control over their diet (e.g. homeless, people in hostels, residential or nursing homes), or a life expectancy < 2 years were excluded. Between February and August 2008 a random sample of eligible patients were sent an invitation letter. Interested participants were invited to phone the research team to arrange a visit to obtain informed consent and complete questionnaires prior to randomization (using a 2:1 ratio in favour of the intervention group). The study was approved by the Liverpool research ethics committee and Liverpool and Sefton PCT Research Management and Governance Collaborative (Clinical trial registration number: ISRCTN54763837).

**Interventions**

Both groups received health promotion literature, including British Heart Foundation patient booklets [17] and were asked to complete a food diary (at baseline and 6-month follow-up). The control group received no further support from the research team.

Members of the research team trained a team of LHTs recruited from the same community as participants, who then delivered the intervention. The theoretical basis of our intervention was derived from social cognition models of health behaviour, including Bandura’s social cognitive theory [18]. This focuses on targeting behaviour change through establishing short-term goals and building self-efficacy. LHTs were asked to: (i) explore the participants’ diet and identify any part(s) they would like to change; (ii) provide information and advice aimed at changing key participant beliefs, such as CVD risk perceptions and outcomes of behaviour change; (iii) explore advantages/disadvantages of change; and (iv) set goals and discuss possible challenges. LHT support was available for 3 months, we suggested contact be made every two weeks (6 times in total), ideally via a face-to-face meeting at a place of the client’s choosing (with additional telephone support, where appropriate). LHTs received supervision and were paid for their time.

**Measuring costs**

**Overview**

For each participant the overall change in cost, over the 6-month trial period, was estimated by summation of LHT and other National Health Service (NHS) and personal social services (PSS) costs. Costs were estimated in UK sterling (£) at 2008/9 financial year levels.

**LHT recruitment, training and supervision**

The time spent by the study team on LHT advertisement, selection (including enhanced Criminal Records Bureau (CRB) checks), training and supervision (post-appointment individual and group sessions) was prospectively recorded throughout the study.

**LHT contacts**

Each LHT was asked to record the number of face-to-face visits with each participant. After discussion with LHTs, these were assumed to last 1 hour. Additionally, to account for the time taken to contact participants, visit preparation and travel we assumed every contact hour was associated with 1.27 hours of non contact time (as estimated for a dietician when conducting a home visit) [19]. For participants who received less than 6 LHT visits we assumed that for every 2 weeks without a visit the LHT would have spent 0.25 hours on the phone (speaking to the individual or attempting to contact them).

**LHT costs**

To calculate hourly LHT employment costs estimated salary on costs (employers’ national insurance and superannuation) and overheads were added to actual wage costs, where these were based on those for a dietician [19], as were travel costs for face-to-face visits. Dietician employment costs [19] were also assigned to the time associated with LHT recruitment, training and supervision and apportioned equally across all face-to-face visits.

We then estimated the total LHT cost incurred in the 6-month trial period by multiplication of the total time associated with face-to-face visits (including non-contact time) and phone calls by the total hourly LHT employment cost, with the addition of any travel costs and LHT recruitment, training and supervision costs.

**Other NHS and PSS costs**

The UK National Institute of Health and Clinical Excellence (NICE) recommends costs be calculated from the perspective of the NHS and PSS [20]. Accordingly, at both baseline and 6 months post randomization, participants were asked to complete a resource use questionnaire which asked about NHS and PSS contacts, including inpatient admissions, health care professional and voluntary group visits. Previously estimated unit costs [19,21] were assigned to such contacts. Participants were also asked to report any prescribed medication they were currently taking, to which unit costs [22] were again assigned. To estimate 6 monthly costs we assumed participants had taken the medication reported at baseline for the previous 6 months and that costs changed linearly between baseline and 6-month follow-up. Summation of the above costs enabled the cost of other NHS and PSS services to be estimated at both baseline and 6-month follow-up. Subsequently, the area under the curve method, with baseline adjustment [23], was used to estimate the change in other NHS and PSS costs over the 6-month trial period.

**Missing data**

In line with previous cost-effectiveness analyses [24], the method of last observation carried forward (LOCF) was used to impute any missing data for other NHS and PSS costs (the recruitment method ensured complete baseline data). If the LHT did not report the number of face-to-face contacts with a particular participant, the mean value for responding participants was used.

**Overall and incremental costs**

By summing LHT costs and the change in other NHS and PSS costs we estimated the mean change in overall NHS and PSS costs over the 6-month trial period for both groups. The mean incremen-
tial cost of the intervention was calculated by subtracting the estimated mean change in overall NHS and PSS cost for controls from that for the intervention group.

**Measuring outcomes**

To estimate the impact on health-related quality of life participants were asked to complete the EQ-5D [25] at baseline and 6 months post randomization. This enabled a cost-utility analysis to be undertaken, where the benefits of different health care interventions can be compared on a common utility scale (where death is equal to 0 and full health 1) [23]. The York A1 tariff [26] was used to assign scores to each EQ-5D health state description. After using LOCF to predict missing EQ-5D scores, the area under the curve method (with baseline adjustment) [23] was used to estimate the mean quality-adjusted life year (QALY) gain/loss over the 6-month trial period for both groups, along with the mean incremental QALY gain for the intervention.

**Cost-effectiveness**

After checking dominance was not apparent (this would occur if one intervention were less costly and more effective than another) [23], the incremental cost per QALY gain [incremental cost-effectiveness ratio (ICER)] associated with the intervention was calculated (mean incremental cost/mean incremental QALY gain). In line with NICE guidance [20] we compared the ICER with a cost-effectiveness threshold ($\lambda$) of £20 000–30 000 per QALY.

**Decision uncertainty**

To estimate the level of uncertainty associated with the decision regarding cost-effectiveness probabilistic methods were used to estimate the cost-effectiveness acceptability curve (CEAC) for each group. The CEAC depicts the probability that an intervention is cost-effective at different levels of $\lambda$ [27].

**Sensitivity analysis**

To assess how robust conclusions were to changes in key assumptions we estimated how results changed when (i) only LHT costs were included (i.e. excluding other NHS and PSS costs); (ii) recruitment and training costs were excluded (as skills may be used over many years these costs could be minimal), supervision costs were still included; (iii) a complete case analysis was conducted; and (iv) only intervention participants known to have $\geq 1$ LHT face-to-face visit were included.

**Results**

**Participants**

Five general practices were recruited and 2275 letters were sent to eligible patients, and 162 subsequently contacted the study co-ordinator. Of these, 117 individuals visited to discuss participation, though three were deemed ineligible as they did not in fact have one of the CVD risk factors. As such, 114 individuals were randomized – 38 to the control group, 76 to the intervention group. However, four intervention participants were recruited too late to be allocated a LHT (3 months of intervention time was not available in the study period) and were subsequently excluded from all analyses. The remaining 38 controls and 72 intervention participants had a mean age of 52.7 years, 59.1% were female, 63.6% had a BMI $> 30$ kg $m^{-2}$, 49.1% had raised cholesterol, 39.1% had hypertension, 13.6% had diabetes and 20.9% currently smoked. There were no significant differences between the two groups at baseline for any of these variables.

**Costs**

**LHT recruitment, training and supervision**

The total professional time associated with advertisement, selection and training of the six recruited LHTs was 222 hours, each of which required a CRB check costing £36 each. Supervision time constituted 15 hours in total. Assuming provision by a dietician (at £26.00 per hour [19]) this constituted a cost of £6378.

**LHT contacts with participants**

The number of LHT face-to-face visits was reported for 59/72 intervention participants, in total 74 visits occurred (mean = 1.25, range 0–7). However, 19/59 participants received no face-to-face visits (many LHTs reported difficulty in contacting participants (13 were never contacted), three participants reported that they did not wish to take part in the LHT programme, two participants were contacted but a visit could not be arranged and one did not attend an arranged face-to-face visit). The mean value of 1.25 face-to-face visits was assigned to the 13 participants who had missing data. Based on the aforementioned assumptions, the mean number of phone contacts was estimated to be 4.76 in the 3-month period (range 0–6, mean total time = 1.19 hours).

**LHT costs**

The mean hourly LHT wage rate was £7.61, with an hourly employment cost of £11.50. Allowing for non-contact time and travel costs (£2.70 per visit [19]), each face-to-face visit was estimated to cost £28.93, and each phone call £2.88.

When the LHT costs associated with training and supervision were added to the aforementioned recruitment, training and supervision costs, the overall cost of such activities was estimated to be £7275 (£1213 per LHT recruited). As LHTs provided an estimated 90 face-to-face visits this equates to an estimated cost of £80.56 per visit, giving an overall face-to-face visit unit cost of £109.49 (£80.56 plus £28.93) per visit.

When these unit costs were combined with the aforementioned LHT levels of resource use, the mean LHT cost for face-to-face visits amounted to £137.32 (range £0–766.41), compared with £13.69 for phone calls (range £0–17.25). The mean total intervention cost was thereby estimated to be £151.01 per participant (range £17.25–766.41) (see Table 1).

**Other NHS and PSS costs**

All participants completed the baseline resource use questionnaire, compared with 24/38 controls and 41/72 intervention participants at 6-month follow-up. Mean other NHS and PSS costs (in the
previous 6 months) at baseline, 6-month follow-up and the change therein are reported in Table 1. The mean costs fell in both groups, but by slightly more in the intervention group.

### Overall and Incremental costs

As LHT costs outweighed the fall in other NHS and PSS costs, mean overall NHS and PSS costs were estimated to be higher for intervention participants compared with controls. The mean incremental cost of the intervention was estimated to be £97.85 (see Table 1).

### Outcomes

Completion rates were the same as for other NHS and PSS costs. The mean baseline EQ-5D scores were 0.829 (controls) and 0.833 (intervention group). After imputing missing data, the 6-month mean EQ-5D score was estimated to be 0.846 for intervention participants (mean gain = 0.113) and 0.915 for controls (mean gain = 0.086), giving mean 6-month QALY gains of 0.028 (range 0.00–0.228) and 0.022 (range 0.00–0.228), respectively. Thus, the estimated incremental QALY gain for the intervention was 0.007 (see Table 2).

### Cost-effectiveness

As the intervention was, on average, more costly and more effective, the ICER was calculated. The incremental cost per QALY gain of £14 480.34 (£97.85/0.007) was more favourable than the cost-effectiveness threshold of £20,000–30,000 per QALY.

### Decision uncertainty

The probability that LHT was cost-effective was estimated to be 39.5% at λ = £20 000 per QALY, 40.1% at λ = £30 000 per QALY, and be <50% at all levels of λ.

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**Table 1** Estimates of the mean baseline, 6-month and change in cost and QALYs associated with each intervention

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>LHT intervention</th>
<th>Difference</th>
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<tbody>
<tr>
<td>LHT costs</td>
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<tr>
<td>Baseline</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>6-month</td>
<td>–</td>
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<td>£151.01</td>
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<tr>
<td>Other NHS and PSS costs</td>
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<td></td>
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<tr>
<td>Baseline</td>
<td>£398.45</td>
<td>£441.33</td>
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<tr>
<td>6-month</td>
<td>£377.17</td>
<td>£366.89</td>
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<td>EQ-5D score</td>
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<td>Baseline</td>
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<td>0.833</td>
<td>0.004</td>
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<tr>
<td>6-month</td>
<td>0.915</td>
<td>0.946</td>
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<td>Change (over 6-month period)</td>
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<td>0.113</td>
<td>0.027</td>
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<td>QALY gain</td>
<td>0.022</td>
<td>0.028</td>
<td>0.007</td>
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</table>

LHT, lay health trainer; QALY, quality-adjusted life year; NHS, National Health Service; PSS, personal social services.

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**Sensitivity analysis**

The results of each of the sensitivity analyses are presented in Table 2. The ICER for the LHT intervention was more favourable than in the base-case in all sensitivity analyses, apart from when only LHT costs were included.

**Discussion**

The LHT provision had an estimated ICER of £14,480, which falls below the threshold value of £20,000–30,000 per QALY, suggesting LHT constitutes value for money. Sensitivity analyses supported this conclusion, with alternative ICERs ranging between dominant and £22,347. Moreover, these estimates could be considered conservative if the benefits of the intervention are sustained beyond the 6-month trial period. The probability that LHT was cost-effective was however only 39.5% at the λ = £20,000/QALY level.

One potential limitation of the analysis is that patient recruitment costs were not included. Such costs were excluded on the assumption that at risk individuals would be detected through everyday practice – many GP practices already undertake systematic screening for vascular risk and a national vascular risk management programme has been recommended for introduction by the UK National Screening Committee [28]. A further limitation was the incomplete costs and QALY data, although analysis based on complete data resulted in a more favourable ICER than the base-case. The 6-month viewpoint could also be considered a limitation, although support for within trial analysis is provided by the fact that changes in behaviour may not be maintained and that presented data can inform longer term decision analytic models.

We are aware of two other studies that have estimated the cost-effectiveness of different lay led interventions [29,30]. In one, lay volunteers were trained to use automated external defibrillators and/or cardiopulmonary resuscitation [29]. The other held group sessions focusing on topics such relaxation, diet and exercise for
people with long-term conditions [30]. In line with our results both produced levels of cost-effectiveness that were considered favourable.

Possible explanations for the finding that the most cost-effective option (according to the ICER) may not have the highest CEAC have been outlined previously [27]. Attributing factors here may be that only 25/41 intervention participants who had complete QALY data achieved a QALY gain and that one-third of intervention participants (19/57 with complete data) did not receive a face-to-face LHT contact. Despite this, the mean QALY gain was estimated to be higher for the LHT group (see Table 1), and higher still for those who received 1 LHT face-to-face visit.

Further (qualitative) research might therefore be undertaken to assess why some individuals seem to engage more with the LHT intervention. This may enable one to modify the intervention slightly, or focus it more on those more likely to engage with it. Both options may improve levels of cost-effectiveness. Furthermore, the relatively small sample size of this study and variability in results suggest there is a need for further research to corroborate our estimates of cost-effectiveness.

Acknowledgements

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References


Table 2 Sensitivity analyses: estimated mean change in cost, QALY gain and ICER for each intervention

<table>
<thead>
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<th></th>
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<td>Overall change in cost</td>
<td>–£21.28</td>
<td>£76.56</td>
<td>£97.85</td>
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<td>QALY gain</td>
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<td>0.028</td>
<td>0.007</td>
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<td>ICER (incremental cost-effectiveness ratio)</td>
<td>–</td>
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<td>–</td>
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<td>LHT contacts (cost over 6-month period)</td>
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<td>Overall change in cost</td>
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<td>QALY gain</td>
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<td>ICER</td>
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<td>–£19.06</td>
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<td>QALY gain</td>
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<td>(n = 27 in intervention arm)</td>
<td>(n = 24 in control arm)</td>
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ICER, incremental cost-effectiveness ratio; LHT, lay health trainer; QALY, quality-adjusted life year.