Modelling the Cost-effectiveness of breastfeeding support

Introduction

Breastfeeding support, designed to encourage greater initiation and duration, can take many forms:

- Peer support – paid and voluntary
- Breastfeeding support centres
- Antenatal education workshops
- Healthcare assistants
- Qualified breastfeeding counsellors/supporters
- Education/training for healthcare professionals
- School education

Whatever form it takes, support utilises scarce resources and therefore has an ***opportunity cost***, in that other alternative uses of those resources have to be foregone. Therefore, it is desirable that such support schemes demonstrate their cost-effectiveness, that is that not only do they 'work' but also provide at least as good value for money as other funded NHS activity.

The primary focus of this analysis is breastfeeding peer support but the simple model developed here could be applied generically to any other intervention designed to support breastfeeding.

Whilst there is much evidence linking breastfeeding incidence and duration with health outcomes, there is less good quality evidence on the efficacy of public health interventions designed to achieve better breastfeeding rates. As was noted in a NICE 2005 systematic review - http://www.nice.org.uk/page.aspx?o=511622

> *"In spite of the importance of this topic area to public health and to the work of the health service, few of the studies reviewed included outcomes related to costs for families, employers or the health services. From the material reviewed here it is not possible to inform the debate on cost effectiveness of interventions to increase the duration of breastfeeding."*

Intervention → Breastfeeding → Health outcomes

? √

This model essentially utilises a "what if" approach. It uses the literature to derive assumptions about the relationship between breastfeeding and health outcomes and, in particular, the "downstream costs" of those outcomes. It then explores the cost-effectiveness of interventions by developing "what if scenarios" for a given cost of intervention, population size and estimated impact of the intervention on breastfeeding initiation. Using sensitivity analysis it is possible to investigate how different scenarios affect results and thresholds for cost neutrality. Clearly, if the net impact of the breastfeeding intervention is cost saving or cost neutral then the cost-effectiveness is established on dominance grounds[1].

However, breastfeeding support may still be cost-effective even if it increases overall costs. This is dependent on the additional benefits being worth the additional costs. NICE generally considers interventions to be cost-effective at an incremental cost-effectiveness ratio of between £20,000 and £30,000 per QALY.

[1] Dominance exists when an intervention is both cheaper and more effective than the alternative (no support in this case)

Baseline Data and assumptions

These are largely based on a paper by Battersby et al. (2004) evaluating the cost-effectiveness of The Breastfeeding is Best Supporters (BIBS) project, a peer support scheme in North Sheffield. The scheme was run by two midwives and had seven paid peer support workers and ten volunteers.

Table 1: Population

Variable	Value	Source	Notes
Population	210	Battersby (2004)	No. of births in the Sure Start Foxhill and Parson Cross area between 1 April 2001 and March 2002

Table 2: Costs and 'downstream' savings

Variable	Value	Source	Notes
Cost of scheme	£19,081	Battersby (2004)	Annual aggregate salaries (£16,972) of peer supp the BIBS project[2] Updated by RPI to 2006 prices
Not breastfeeding cost of gastroenteritis, respiratory infections and otitis media in 1st year of life	£301	Ball and Wright (1999)	Range £206 - £296 per infant (mid-point £251) Cited by Battersby (2004) Updated by RPI to 2006 prices
Daily cost of formula milk	£1.00	Morrell at al. (2000)	Average weekly quantity of powdered infant formu totally bottle fed baby is 900g. Cost of 900g tin is Updated by RPI to 2006 prices
Pre-menopausal breast cancer	£488	Woolridge (1995)	Cited by Battersby (2004) in deriving a saving of £ for averting three cases of pre-menopausal breast Updated by RPI to 2006 prices

[2] Non-salary costs of the project are not given and therefore this figure underestimate the total costs of the project, although salaries are likely to be by far the most important cost element

Table 3: Effectiveness			
Variable	**Value**	**Source**	**Notes**
Initial breastfeeding rate	22%	Battersby (2004)	
Increasing in breastfeeding rate[3]	27 p.p.	Battersby (2004)	
Initial average breastfeeding duration	67 days	Battersby (2002)	The estimation method is described in appendix 1
Increase in average breastfeeding duration	37 days	Battersby (2002)	The estimation method is described in appendix 2
Breast cancer risk (never breastfed)	0.063	Collaborative Group on Hormonal Factors in Breast Cancer (2002)	
Relative risk reduction in breast cancer for every 12 months additional breastfeeding	4.3%	Collaborative Group on Hormonal Factors in Breast Cancer (2002)	See appendix 3
Hospitalisation due to infection risk (never breastfed)	0.126	Talayero et al. (2007)	
Relative risk reduction for hospitalisation due to infection for every additional month breastfeeding	30.1%	Talayero et al. (2007)	See appendix 4

Table 4: QALYs			
Variable	**Value**	**Source**	**Notes**
NICE willingness to pay for a QALY threshold	£20,000	NICE	
QALY gain from averted Infection requiring hospitalisation	0.00		
QALY gain from averted pre-menopausal cancer	0.00		

[3] The increase of 29 percentage points from 22% before the study to 49% as a result of the study.

Results

With baseline data and assumptions the model suggests that an investment of £20,000 in a peer support scheme of this type produces net societal savings of £5,500, after “downstream savings” from increased breastfeeding initiation and duration are taken into account. In addition the model suggests that the scheme would avert 0.057 cases of pre-menopausal breast cancer in mothers (2.7 cases per 10,000) and almost 6 cases (285 cases per 10,000) of infections requiring hospitalisation in the first year of life. However, as the scheme is estimated to produce net cost-savings without considering these additional benefits, it is not necessary to convert the additional benefits to QALYs.

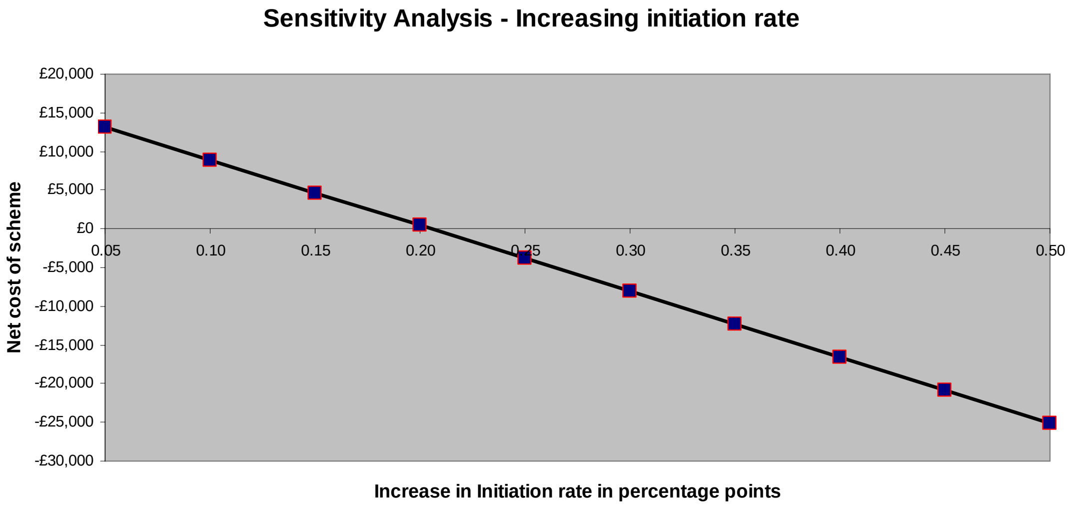
Sensitivity Analysis

Sensitivity analysis is used in economic evaluation to assess how sensitive the results of the model are to the assumptions made about the model parameters, particularly those parameters where considerable uncertainty exists as to their actual value.

One way sensitivity analysis involves altering the value of a single parameter, holding all the others constant, to determine how sensitive the cost effectiveness conclusion is to the assumptions made about that particular parameter. Multi-way sensitivity analysis means that several default parameters are changed simultaneously.

The one-way sensitivity analysis below graphs the effect of changing the assumption about the efficacy of the intervention in terms of breastfeeding initiation while holding all other parameters constant.

Figure 1



This graph indicates how the net costs of the scheme fall as a result of increased initiation. A threshold analysis suggests that an increase in initiation of 20.5 percentage points is necessary for cost neutrality, holding all other factors constant. For any initiation greater than this the scheme would be unambiguously cost-effective. Each additional 1 percentage-point increase in initiation leads to an £850 reduction in net costs.

Figure 2 shows how the net costs of the scheme are affected by varying the efficacy of the intervention in terms of increased duration, holding all other factors constant. It suggests that the scheme would still dominate even if there was no impact on average duration of breastfeeding.

Figure 2

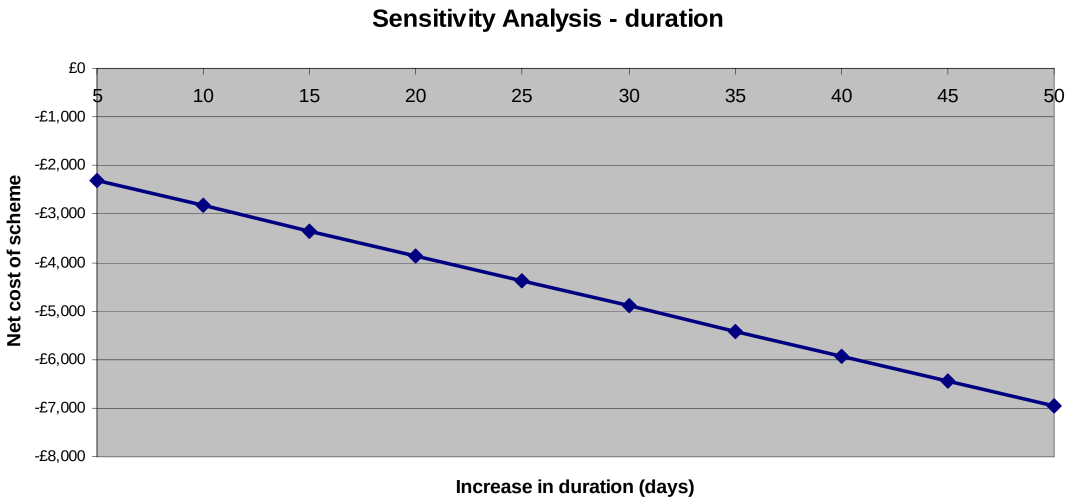
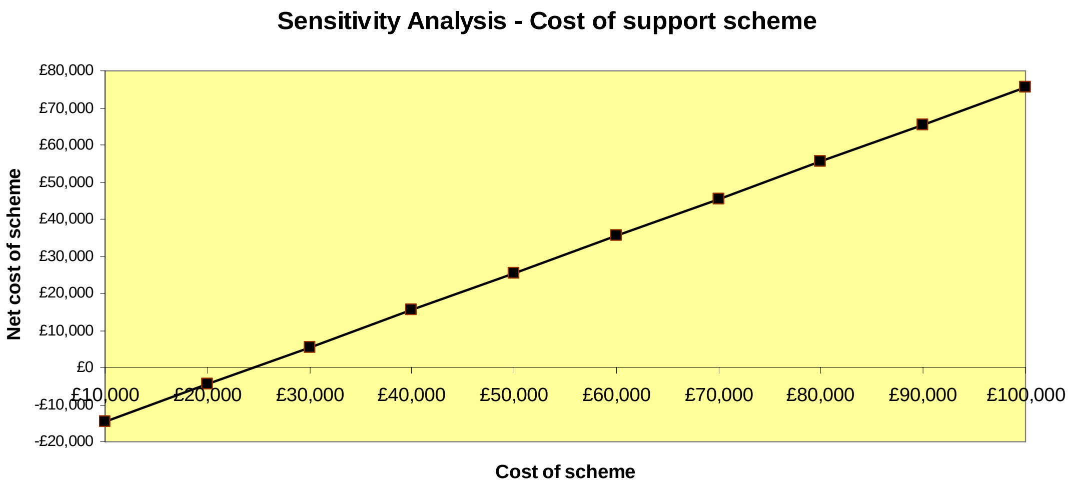


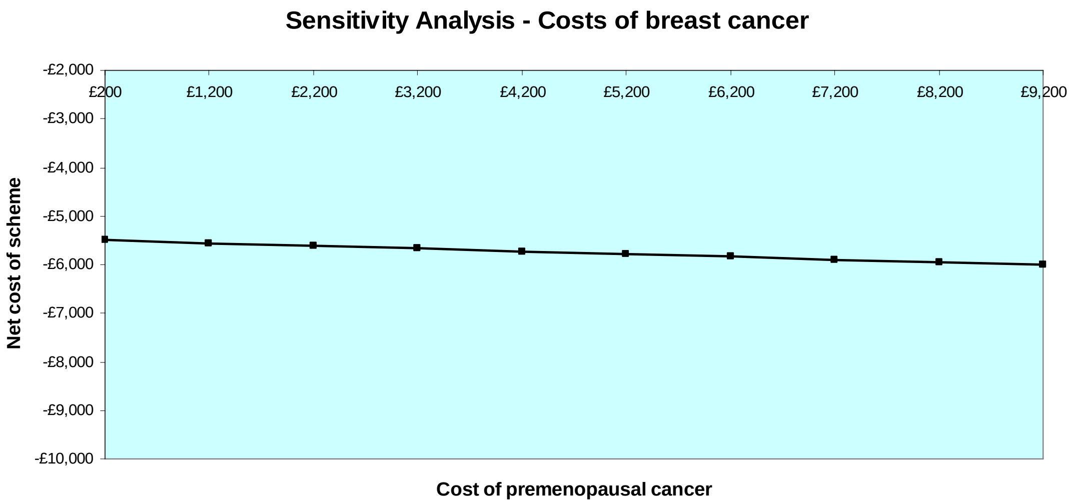
Figure 3 below shows how the incremental costs vary with the costs of the scheme holding efficacy constant. It shows that a scheme costing £24,598 is the threshold value for cost neutrality. For scheme costs below this threshold value the scheme is unambiguously cost-effective.

Figure 3



Finally, figure 4 shows that the incremental costs of the scheme are not particularly sensitive to changes in assumptions about the cost saving from averting a pre-menopausal breast cancer.

Figure 4



Discussion

Due to the rather limited nature of data linking interventions to outcomes, the analysis presented has made a number of simplifying assumptions and focused on a "what-if" approach. The sensitivity analysis can demonstrate what a breastfeeding support scheme would have to cost for a given population and efficacy in order to be cost neutral or saving.

Similarly, the "what-if" approach can suggest how changes in breastfeeding initiation and duration impact on the net cost is necessary for a scheme of certain cost and population in order to achieve either cost neutrality or cost savings.

The baseline result shows that a breastfeeding peer support scheme of this type would be unambiguously cost-effective producing health benefits and net savings compared to its alternative, which is routine breastfeeding support in this case.

The cost of the scheme, for reasons outlined earlier, is a lower bound estimate of the actual cost. However, even with an intervention cost which doesn't generate net savings it does not automatically follow that the intervention isn't cost-effective. Ultimately this rests on a value judgment as to whether the incremental benefits from the intervention, in this case a reduction in gastroenteritis, respiratory infection and otitis media in infants and a small reduction in breast cancer, are worth the incremental costs.

NICE uses a threshold of £20,000 to £30,000 per QALY to assess cost-effectiveness. So even if the scheme has a net cost, it would still be cost effective if the QALY gain from reduced infections and breast cancer is achieved at less than £20,000 to £30,000 per QALY.

We should also note that some of the limitations of this model may also cause cost-effectiveness to be under-estimated. The model focused on outcomes where the evidence of a health benefit from breastfeeding is greatest. However, breastfeeding may have health benefits over and above this. Furthermore, breastfeeding has also been linked with improved educational and social outcomes. If the model underestimates both the benefits and "downstream" cost savings arising from breastfeeding, then the cost-effectiveness of public health interventions to encourage increased initiation and duration will be greater than implied by the model.

However, the real area of uncertainty in this area, and where greater research is needed, is the change in breastfeeding behaviour which can be accurately attributed to specific public health interventions. A recent Department of Health report evaluated a large number of Breastfeeding Practice Projects 1999-2002 and whilst projects that reported on breastfeeding rates tended to show an increase they were not based on experimental study designs and there are many methodological issues in using historical controls. In particular it was suggested there would be a confounding effect of the Baby Friendly Initiative for many of these projects.

In summary, a scheme to increase breastfeeding ,costing about £100 per mother, will break even in terms of lower feeding costs and reduced future hospital admissions if there is about a 20 percentage-point increase in initiation rates of breast-feeding. (This does not take account of lower rates of breast cancer of the mother, the trauma of hospitalisation of the infant, or the opportunity cost of the alternative use of scarce health-care resources.) For a 30 percentage point increase in initiation, the gain to society for each initiating mother is about £400 (about £125 averaged over all mothers) compared with the £100 cost per mother of the scheme. If the health gains for both mother and are considered, a scheme costing £100 per mother and yielding breastfeeding initiation rate increases of a little less than 20 percentage points is likely to be cost effective.

Appendix 1 – Estimation of initial breastfeeding duration

Battersby (2002) reports the following as the baseline for breastfeeding prior to the commencement of the Breastfeeding is Best Supporters (BIBS project):

Table 1: Data from the Health Visitor Audit 1998

Breastfeeding at birth	22%
Breastfeeding at 6 weeks	10%
Breastfeeding at 4 months	2.5%

(Source Fox L. 1998. Foxhill & Parson Cross Sure Start Application Document)

This data was used to estimate the average breastfeeding duration (Table 5). It was assumed that those stopping in a particular time period did so at the mid-point between the beginning and start of period.

Table 5: Mean duration of breastfeeding pre-BIBS

Battersby period	Value (1)	Continue Next period (2)	Estimated period	Mid-point duration	Value (1) – (2)	Weight (% BF)	Weighted days BF
Breastfeeding at birth	22%	10%	0-6 weeks	21 days	12%	54.55%	11.45
Breastfeeding at 6 weeks	10%	2.5%	6 wks - 4 mths	82 days	7.5%	34.09%	27.95
Breastfeeding at 4 months	2.5%	n/a	4 mths – 12 mths	244 days	2.5%	11.36%	27.73

The weight gives the percentage of all woman breastfeeding who breastfed for a particular duration, estimated as the mid-point of a period. By multiplying the mid-point duration by the weight it is possible to derive a weight number of days for each of the 3 durations estimated. Then, by summing these weights, an estimate of the average duration of breastfeeding is derived:

11.45 + 27.95 + 27.73 = **67 days**

Appendix 2 – Estimation of breastfeeding duration after intervention

Battersby (2002) reports the following data for the BIBS project:

Table 2: Sure Start Data 1.4.01 – 31.3.02

Total Births	**210**	
No data	15	7.15%
Initiated breastfeeding	103	49.05%
Initiated formula feeding	92	43.80%
Total	**210**	**100%**
Still breastfeeding 4 weeks	66	31.50%
Still breastfeeding 3 mths	39	18.60%
Still breastfeeding 6 mths	23	11.00%

(Source: BIBS database & Sure Start database)

This data was used to estimate the increase in initiation due to the project[4];

49.05% - 22% = 27%

The data was also used to estimate the change in the mean duration of breastfeeding arising from the intervention (Table 6).

[4] It was conservatively assumed that the women did not breastfeed where there was no data

Table 6: Mean duration of breastfeeding BIBS

Battersby period	Value (1)	Continue Next period (2)	Estimated period	Mid-point duration	Value (1) – (2)	Weight (% BF)	Weighted days BF
Breastfeeding at birth	49%	31.5%	0-4 weeks	14 days	17.5%	35.78%	5.01
Breastfeeding at 4 weeks	31.5%	18.6%	4 wks - 3 mths	60 days	12.9%	26.30%	15.78
Breastfeeding at 3 months	18.6%	11.0%	3 mths – 6mths	137	7.6%	15.49%	21.23
Breastfeeding at 6 months	11.0%	n/a	6 mths – 12 mths	274 days	11.0%	22.43%	61.45

By summing up the weighted days, the mean duration of breastfeeding as a result of BIBS can be estimated.

5.01 + 15.78 + 21.23 + 61.45 = 103 days

This is an increase in duration of **36 days** compared to the estimation for the pre-intervention mean duration.

Appendix 3 – The dose response relationship between breastfeeding and the risk of hospitalisation due to infection in the first year of life

A study by Talayero et al. (2007) reported that “every additional month of full breastfeeding would prevent 30.1% of hospitalisations as a result of infection in children who had not received full breastfeeding that month”. Therefore, the estimated relative risk reduction of a month of full breastfeeding is 0.699. The relative risk reduction of each additional day of breastfeeding was estimated as follows:

Relative Risk 1 months breastfeeding = 0.669

Relative risk of 1 day breastfeeding = $0.669^{(1/(365/12))}$ = 0.9883

Note This is likely to be an overestimate if the risk of hospitalisation is a declining function of age – i.e. the 30.1% probably refers to a declining absolute no. That would also seem to tie in with the later observation that FB for 4 months or more would have prevented 56.4% of admissions

Appendix 4 – The dose response relationship between breastfeeding and the risk of breast cancer

A study by the Collaborative Group on Hormonal Factors in breast cancer estimated that the "relative risk of breast cancer is reduced by 4.3% (95% CI 2.9 – 5.8) for each year that a woman breastfeeds". In other words the relative risk of 12 months breastfeeding for breast cancer compared to never breastfeeding is 0.957.

The study finds a dose-response relationship with each increase in lifetime breastfeeding duration giving increased protection. It also finds a protective effect for lifetime breastfeeding duration of <6 months compared to never breastfed. In our model it is necessary to model the reduction in relative risk for each additional day of breastfeeding. This was done as follows:

Relative Risk 12 months breastfeeding = 0.957
Relative risk of 1 day breastfeeding = $0.957^{(1/365)}$ = 0.99988

This study also reports a cumulative incidence of breast cancer of 6.3 cases per 100 women by age 70 years in the developed countries and the model uses this as a woman's baseline risk in the absence of breastfeeding[5].

[5] This is most likely an underestimate at the cumulative incidence is based on a population of women, in which a proportion would breastfeed