The costs of a community-based intervention to promote maternal health

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Abstract

The costs of community-level interventions are rarely reported, although such insights are needed if intervention research is to be useful to practitioners seeking to understand what might be involved in replicating interventions in different contexts. We report the costs of a 2-year community-based intervention to promote the health of recent mothers in Victoria, Australia. Program of Resources, Information and Support for Mothers was an integrated programme of primary care and community-based strategies. It had health care professional training, health education and community development components as well as an emphasis on creating ‘mother-friendly’ environments. Costs included the programme costs [primarily the salaries of the community development officers (CDO) in the field] and also ‘induced’ costs that relate to the CDOs’ successes in attracting additional resources to the intervention from the local community. The total cost averaged A$272 490 per rural community and A$313 900 per urban community, equivalent to A$172.40 and A$128.70 per mother, respectively. For every A$10 of public funds initially invested in the project, the CDOs were able to attract a further A$1–2 worth of local resources, predominantly in the form of volunteer time or donated services.

Introduction

Evidence on the costs of health-promoting interventions is mixed in quality, varied in quantity and limited in scope since most of the available economic evidence relates to clinical interventions such as vaccination or lifestyle interventions such as behavioural counseling [1]. Some areas of health promotion practice such as tobacco cessation and workplace interventions appear reasonably well evaluated from an economic perspective. Others, most notably interventions that target environmental, social and economic determinants of health, are almost untouched by economics [1].

We report here an evaluation of the costs of an innovative, community-based intervention designed to promote the physical and mental health of recent mothers. Program of Resources, Information and Support for Mothers (PRISM) was an integrated programme of primary care and community-based strategies. Key elements of the PRISM intervention included training for family practitioners and maternal and child health nurses (MCHN), a resource kit for parents and a range of community-based initiatives designed to create a more ‘mother-friendly’
The training programme aimed to improve the ability of clinicians to recognize and respond to common health problems experienced by recent mothers. The resource kit provided information to parents about the health consequences of childbirth and the services and supports that were available locally. It also included a collection of vouchers donated by local businesses that offered discounts on goods and services. The community-based activities were initiated by a community development officer (CDO) employed in each of the eight local government areas that acted as intervention communities. The role of the CDO was to engender local support for the intervention and to encourage mother-friendly changes in the physical and social environment. An important element in this respect was the establishment in each intervention community of a steering committee made up of representatives drawn from local agencies and organizations and including local resident mothers.

The design of the intervention was based on literature review and extensive fieldwork by the PRISM trial investigators in which they surveyed the prevalence of health problems and identified needs among recent mothers [2-4]. Full details of the intervention strategy are available from the programme’s designers [5].

Initial approaches to the local government areas inviting participation were made in March 1998 [6]. A sample of 16 communities was selected and randomization to intervention or comparison group was made in June 1998 [7]. The CDOs received initial orientation to the project in November 1998 and started work in the communities the following month, on 1-year contracts initially, later extended by a further 12 months. The training programmes for family practitioners and MCHNs took place in 1999 with a refresher in March 2000. The first ‘PRISM baby’ (which dates the first mother to be enrolled in the study) was born in February 2000. Recruitment of mothers into the outcome evaluation was initially planned to take 12 months and was extended during the life of the project to 18 months to increase the sample size.

Some aspects of the implementation of the intervention and its effect on health outcomes were evaluated separately by the PRISM team within the context of a cluster randomized trial [8]. Disappointingly, the trial investigators report that the intervention had no effect on physical health (as measured by the Medical Outcomes Study 36-item short form health survey [SF-36]) or mental health (as measured by the SF-36 and the Edinburgh Postnatal Depression Scale) at 6 months after birth [9]. A follow-up of outcomes 18 months later is in progress.

The EcoPRISM project, on which the authors of this paper were engaged, ran in parallel to the PRISM trial and added an economic and ecological component to the evaluation. We chose to run the economic evaluation prospectively, alongside the PRISM team’s evaluation of effectiveness because of the need to capture the costs and immediate consequences associated with the myriad of activities that the CDOs were expected to initiate during their tenure: something that was best done in real time rather than retrospectively because of the risk that the CDOs would overlook the everyday aspects of their activities [10].

**Methods**

Estimating the cost of any health intervention involves three steps: identifying the resources involved in the delivery of the intervention or affected by it in some way, measuring the change in resource use brought about by the intervention and, finally, valuing where possible that change in resource use according to economic principles.

Seven categories of resource use were identified. These were costs associated with (i) planning the intervention and overseeing its implementation; (ii) the employment of the CDOs in each of the eight intervention communities; (iii) the community activities initiated as a result of the CDOs’ efforts, which included a public launch of the intervention in each intervention site; (iv) the preparation and distribution of the resource kits to mothers; (v) the work of the steering committees established in each of the eight intervention communities; (vi) the training of family practitioners and MCHNs.
and finally (vii) the net effects of the intervention on related health service use.

**Measurement and valuation of resource use**

**Planning and oversight**

Costs associated with the centralized planning and supervision of the intervention related mainly to the time of two of the PRISM research team members whose responsibilities spanned both implementation and research. Time diaries were used to measure this input over the course of the intervention. The diaries were used to record time spent on PRISM-related management and supervision, all research activities including PRISM-related research and other ‘overhead’ costs. These activities were recorded for a random sample of 1 week in every 4, for a period of 35 months. The time attributed to the PRISM intervention included the hours spent on PRISM-related administration and other non-PRISM activity was excluded from the evaluation. The actual salaries of the research staff providing this managerial input, including on-costs, were used to translate these hours into an estimate of costs.

**Community development officers**

CDOs were employed full time, initially for 1 year, later extended by a further 12 months in each of the intervention communities. The role of the CDO included liaison with local agencies, organizations and clinicians; compiling information and soliciting vouchers for inclusion in the information kit; establishing supportive social networks for mothers and providing support to the local PRISM’s steering committee. The CDOs were based in local government but were employed by La Trobe University. Salary costs for the CDOs were met from the PRISM intervention budget and this expenditure was used to estimate the staff costs. To this, we added an amount equivalent to 10% of the CDO salary to represent the economic costs incurred by the local government agencies in providing office accommodation and supplies.

**Community-based activities including the launch of the intervention**

A major part of the CDO’s time was devoted to encouraging mother-friendly changes in each locality. Examples of such community-based activities initiated by CDOs included encouraging local government to improve footpaths, facilitating the establishment of social groups for recent mothers and encouraging other agencies such as the local library to hold events such as reading clubs for mothers and their children. The form that these changes took in each local government area depended on whatever opportunities presented themselves or could be created by the CDO.

This element represented the most difficult item to cost since, with the exception of the launch of the PRISM intervention, we could not predict in advance what events would take place, where they would occur or when they would occur. To document community activities, we adapted the idea of ‘event logs’ first used to evaluate the actions taken by community-based coalitions [11]. The event logs were tailored to the personal styles of each CDO [10, 12] and completed by them as a way of recording PRISM-related actions and their outcomes. An action might be something such as ‘met with the manager of the local supermarket to ask if she would consider increasing the number of reserved parking spots nearest the entrance so that mothers with strollers might also benefit’. If the changes to the parking arrangements then took place, this would be documented subsequently as a PRISM-related outcome.

The event logs were used by the CDOs to record a wide range of PRISM-relevant activities and outcomes, not just those that had resource consequences. All events were coded by a member of the EcoPRISM team and the details of all resource-sensitive codes were then extracted for subsequent costing. Many of the resource-sensitive events related to the donation of time to participate in PRISM-related activities such as preparation and distribution of newsletters. Where the information was available, an estimate of the costs of each event was based on the actual time provided multiplied by...
standard salary costs relating to different categories of staff. If sufficient details were not provided in the event log (e.g. the number of hours was missing), then we based our estimate of costs on similar activities documented more completely elsewhere in the event logs of this or one of the other CDOs.

A second category of event related to environmental or policy changes that were initiated by the CDOs, such as the change in parking policy mentioned above. Thus, some of the local councils installed baby change tables in public conveniences and one neighbourhood group was awarded $10 000 to provide shading against the sun in a local park. There were 27 such events recorded over the course of the intervention, most of which related to the installation of baby change facilities. Our own resource constraints prevented us from building an estimate of the costs of every such event from first principles. Instead, where the financial implications of such events were recorded, we used this as the basis for our costing. In the absence of such information, we compiled a list of standard costs based on our best estimates of the value of the resources required to implement the policy and used these data instead.

At the request of the PRISM trial team, there was a formal launch of the intervention in each intervention site. While the precise content of each launch varied across communities, each took the general form of a ‘festival’ with speeches from local dignitaries, refreshments, presentations by health professionals and various hand-outs and free offers such as brief massages. The event logs proved a useful way of documenting the physical resources committed to the launch.

**The resource kit**

The resource kit comprised a booklet that provided information for parents including descriptions of the types of health problem often encountered following childbirth and a directory of services that were available locally. Production of the kits was contracted to a local design firm and so this cost is represented by actual expenditure. Distribution of the kits was delegated to the MCHN, who usually see every recent mother at least once. Most of the nurses reported that it took at least 5 min to take the mother through the content of the kit. To reflect the value of this time input, we have included in the cost of kit distribution an amount equivalent to 5 min of an MCHN salary for every kit handed out.

One element of the resource kit proved especially difficult to cost. Each CDO was responsible for encouraging local businesses to supply vouchers providing discounts or special offers on relevant goods or services to participating mothers. Thus, local cafes might provide a voucher allowing new mothers a free cup of coffee and hairdressers might offer a discount to new mothers if they attended on certain days.

In theory, the variable cost associated with the service or discount provided represents a resource cost incurred by the local trader who donates the voucher. This cost should be included in any comprehensive estimate of resource use. While the retail price of the otherwise ‘free’ coffee might be say $2.50, the variable cost would be somewhat less than this, though precisely how much less is not known. Moreover, many vouchers offered the bearer a percentage discount off purchases of any size, and without knowing what the total expenditure was in each of these transactions, it was impossible to estimate the associated resource cost. On the other hand, it is possible that traders only offered a voucher if they anticipated an associated benefit either from additional purchases made at the same time as the voucher was redeemed or from future trade. The net cost to the trader might be close to zero, therefore.

To add to our difficulties, we were unable to track voucher use reliably. Traders were happy to honour the vouchers, but for various reasons, very few of the vouchers that were redeemed found their way back to the PRISM study team for reconciliation.

Two avenues were open to us. The first was to cost the vouchers as issued to mothers (rather than those actually redeemed) and to do so at face value, making assumptions about the average size of purchase qualifying for a percentage discount. The second was to exclude any costs associated with the vouchers. The former would overstate the
resource costs quite considerably; the latter would understated them. In the baseline estimates, we exclude costs associated with the vouchers, and we explore the consequences of this decision in the Discussion.

Steering committee
Each of the intervention communities established a steering committee to champion the PRISM intervention, oversee its local implementation and work towards its future sustainability once the research phase ended. Steering committees met frequently, often monthly, and so membership implied a substantial commitment of time to the intervention. While not associated necessarily with any financial costs, this does represent a significant resource cost. The minutes of the steering committee meetings were used to identify the number and composition of the members in attendance and to quantify the time taken for each meeting. An estimate of the resource cost was then derived by multiplying the duration of each meeting plus an allowance for travel to and from the meeting by a standard hourly cost that varied according to the type of person in attendance.

Professional training
The next component of the costing was the resources associated with the professional training provided to family practitioners and the MCHNs. The design and evaluation of the family practitioner-training programme was part of a separate research project, called guidelines for assessing postnatal problems (GAPP) [13]. The training programme comprised a series of workshops plus visits from simulated patients. The GAPP team documented the costs associated with the training programme. We have taken these costs from the report of the GAPP project, supplemented them where they were deficient and converted the result to 2002 prices.

Training was also provided in workshop sessions to the MCHNs in each local government area. Our estimate of costs includes the time spent by the members of the PRISM research team in preparing and delivering the workshop content, their travel to and from the workshops, the costs of the workshop materials and the time of the MCHNs who attended the workshop.

Changes in health service use
The final element of the costs associated with the PRISM intervention was any changes to health service use that the intervention brought about. It was not possible to predict the direction of this change a priori. To the extent that the intervention was successful in preventing health problems, one might expect a reduction in subsequent health service use. However, many health problems among recent mothers go undetected despite the fact that new mothers have frequent contact with health professionals. Given the emphasis within the training element of PRISM on identifying and responding better to such problems, it is just as conceivable that health service utilization would increase at least for less severe problems. To assess changes in health service, we obtained aggregate Health Insurance Commission data on the number of general practitioner and specialist consultations for mother–child dyads in each of the participating local government areas for 1 year prior to the intervention through to 1 year post-intervention.

Further considerations: timing and adjustments
There are two further complications to discuss before we present the results of this study. The first relates to the timing of the intervention and what bounds to place around its evaluation. Most of the first year of the CDOs’ tenure was spent establishing working relationships within each community, planning for the launch of the intervention, working on the locality guide and securing vouchers for the resource kit in advance of the first PRISM birth. In the second year, the CDOs focused more on setting up community-based structures to support the mothers who would later be included in the outcomes survey: structures that it was hoped would continue to support mothers beyond the period of CDO funding. The way the project unfolded in each intervention community was not as discrete as this, however. Rather, it is in the nature of community-based interventions such as this that the characteristics of
the intervention evolve in response to changing local circumstances [14]. In addition, some costs were incurred after the employment of the CDOs ended since not all of the policy changes agreed to as part of PRISM had come on stream and many initiatives started by the CDOs continued beyond their tenure.

In any costing exercise, it is desirable to estimate the recurrent costs of a programme once it reaches a steady state so that one can distinguish learning costs from programme costs, and within the latter category to distinguish ‘start up’ costs from recurrent costs. This proves difficult when, as here, it is hard to say precisely when the intervention started or when it ended. The problem is compounded because of problems placing bounds around the population most affected by the intervention. The PRISM trial set out to evaluate outcomes in a cohort of mothers beginning in February 2000 (14 months after the CDOs started work) and recruiting through to July 2001 (7 months after the CDOs’ employment ended). Each mother’s ‘exposure’ to the intervention therefore varied across this cohort. For example, mothers who were recruited at the very beginning of the trial had a longer period of overlap with the time that the CDOs were employed. Mothers who were recruited at the end of the trial had no overlap with the CDOs, and if they were to benefit at all would do so only as a result of any sustained activity that the CDOs had managed to initiate. Such changes would also continue to exert an influence over future cohorts of mothers, beyond those recruited to the trial.

We counted the total costs of the intervention from initial recruitment of the CDOs until 6 months after the end of their tenure. Since costs were incurred over several years, costs in Years 2 and 3 have been discounted at 3% [15]. All costs are expressed in Year 2002 prices in Australian dollars. To express the total as an average cost, we have used three different estimates of the exposed population (Table I). The baseline estimate of costs uses the number of resource kits that were distributed as its estimate of the exposed population. To provide an upper bound to the estimate, we also report the cost as an average only over those mothers who gave birth during the period when the PRISM team was surveying outcomes (February 2000 to July 2001). To provide a reasonable lower bound, we report costs per mother who gave birth at any time during the period of the intervention and its evaluation (November 1998 to February 2002).

Apart from what bounds to place around the scope of the intervention in order to define the denominator population, the second issue relates to estimating its net cost over and above that incurred in the eight comparison communities. To avoid contaminating the intervention, we could not collect primary data from the comparison communities. Each comparison community entered into a memorandum of agreement with the PRISM team not to introduce any of the key elements of PRISM (the professional training programme, the information kit, the vouchers and the befriending activities), and

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so we have assumed that the costs of the PRISM-related activities that we document here occurred only in the intervention communities. This accurately reflects the cost of becoming a PRISM community but will overstate the incremental cost of PRISM, if comparison communities did in fact introduce any the PRISM key elements.

Results

To maintain the confidentiality of the participating communities, we have aggregated the results by type of local authority (rural or urban). Costs are presented as an average per type of community and as an average cost per mother using the three populations described above (Table I). The total (discounted) cost of the intervention excluding the value of the vouchers averaged $272 490 in the rural communities and $313 900 in the urban communities (range within communities was $253 480–397 225).

The biggest single item of cost was the salary of the CDO, which represented 40% of the cost in urban communities and 46% of the cost in rural communities. The CDO costs were also responsible for much of the variation in the average cost per mother since each participating community had a full-time CDO irrespective of its size as measured by the number of births expected in any one year.

There were no significant differences between intervention and comparison communities in the number of consultations with family physicians or hospital specialists or any significant change in the trend of these costs over time within communities.

In summary, the average cost per mother across the participating communities ranged from $91.40 to 425.80 and averaged $172.90 in the rural communities and $129.90 in the urban communities.

These figures exclude any allowance for the value of the vouchers that the CDOs were able to procure for the resource kits. In fact, the CDOs were very successful at engaging local traders and securing vouchers for the resource kits. Taken at face value, the value of the vouchers across all eight communities exceeded $5.5 million, and ranged from $94 000 in the smallest community to $1.85 million in one of the larger communities.

Discussion

To our knowledge, this is one of the first prospective evaluations of the cost of a community-based intervention aimed at promoting the health of recent mothers through a range of clinical and community-based activities. Average costs per mother varied across the eight participating communities, mainly because of differences in population size and the consequent variation in the number of births occurring among the local government areas. Cost per mother, even in the most expensive community, remained <$750. However, as the intervention was not successful in improving health outcomes, this cannot be considered a cost-effective use of resources.

Nonetheless, there is useful information here despite the disappointing result. First, there is very little evidence available on the costs involved in delivering any community-based interventions of this scale, even though the type of activities carried out and the mode of delivery are common among many types of health promotion programmes [16]. Providing such information corresponds to the recent call by Glasgow et al. [17] for the routine collection and reporting of data that could be used to draw conclusions about a study’s external validity.

Second, costing community interventions raises methodological issues not often encountered in economic evaluations of clinical interventions. Our experience in costing PRISM sheds some light on these issues that will be valuable for others embarking on similar exercises. Third, among the reasons offered by the trial investigators for the null result on the outcomes’ side is at least one that could possibly be overcome by greater investment in the intervention, which would increase the costs of the programme. Our analysis of the structure of the costs of PRISM allows us to explore how its costs might change if the intensity of the investment was increased.
Among the reasons offered by the trial investigators as to why PRISM did not have the anticipated effect, at least one is a consequence of the level of investment in the intervention and therefore in its costs. This is the 2-year duration of the CDO contracts, which the trial investigators suggest may have been too short [9]. Certainly, there was some tension over what the CDOs could achieve in this time frame and what priority was to be given to competing activities [12]. It is plausible therefore that the other aspects of the intervention may have landed on more receptive ground had the CDOs been given more time to establish and mobilize the community resources in advance of the recruitment of mothers to the outcome study. A longer tenure would also have allowed more of the cohort of mothers to benefit directly from the activities organized by the CDOs (e.g. events, meetings, media attention) rather than simply the educational resources the CDOs created or the policy changes that they affected.

If the same CDOs were employed for 3 years instead of 2, then the total cost of the intervention would increase by 48%, increasing the average cost per mother to $192.30 in urban communities and $250.90 in rural ones. The salary costs of the CDOs, the costs of central administration and management and the costs of the steering groups would each increase pro rata by 50%. Costs associated with the preparation and distribution of the resource kit preparation and the professional training would not change. However, the costs of community activities and other resources drawn into the evaluation by the CDOs would probably increase by >50% because much of the ground work in establishing and promoting the necessary community partnerships and networks would have been accomplished and more time could then be devoted to initiating activities and events. To get some handle on the expected increase in costs, we have assumed that the costs of community activities would double with the addition of a third year.

The costs of expanding the programme could be reduced a little if, instead of adding a third year to the contracts of the current CDOs, additional staff were employed to double the number of CDOs in the second year of the intervention. Total costs then increase by 39%, to $182.20 per mother in urban communities and $235.70 per mother in rural ones.

Some indication that a larger investment in CDO time might have positive benefits comes from the event log and other data sources that have informed the costing work [10]. Similar methods used to document community development activities in other projects typically show that the pace of change accelerates after Year 1 and can be quite marked by Years 2 and 3, as the intervention unfolds [11]. Factor in an additional lag between policy change and effect and we have what might amount to a suboptimal dose in the PRISM study cohort.

Of course, the PRISM intervention may still be found to be ineffective, even after increasing the preventive dose and accounting for longer lag times. There are, however, still lessons to be learnt from our experiences in trying to document the costs of the intervention as it unfolded by those who may be engaged in similar activities in future. While the intervention had common and predictable elements in the community development workers, the professional training and the resource kit provided to mothers, the importance of the community activities and changes in policy initiated by the CDOs meant that the form that the intervention took (and therefore the costs that would be incurred) was never going to be uniform across all intervention communities. The more successful the CDOs were in initiating activities across the intervention communities, the more difficult it would become to document the changes and measure the costs accurately.

Our main method of tracking these activities was the completion of the event logs by the CDOs. Event logs have proved useful in evaluating the activities of community coalitions in health promotion, but we believe this to be the first time that they have been used to measure costs in an economic evaluation. By verifying independently a sample of the activities and events that were recorded in the logs, we know that there was no over-reporting of events. The logs had to be sensitive to the competing demands on the CDOs, however, and when time was short we agreed that the
completion of the event logs was the first activity that should give way. This meant that the detail relating to many of the events was missing, and the number of events was under-reported also.

As we have indicated, it also proved problematic to track voucher use. The voucher scheme had high levels of support among traders, but soliciting the vouchers proved time-consuming for the CDOs and monitoring their use was not of high priority. There was less enthusiasm among some CDOs when a second round of vouchers had to be obtained for a reprinting of the resource kit. Some of the difficulty associated with the vouchers included dropout of traders, as businesses changed hands or ceased trading. This said, the vouchers provided one vehicle through which local businesses could become more involved with their community and this prompted some discussion between the two research teams about the precise value of this component of the resource kit. Did it matter, for example, if the vouchers were not used? That is, would the mere provision of the vouchers convey benefit symbolically by showing mothers that they were valued? We cannot answer such questions and this aspect of the intervention requires further study.

While it was difficult and expensive to track costs prospectively, our experiences suggest that it would have been close to impossible to do so retrospectively with any degree of accuracy because of the number and range of activities initiated over the period of the intervention. The margin of error would increase as the intervention matured and the pace of policy change increased. With hindsight, one might conclude from the null result on the effectiveness side that we would have made better use of research resources had we waited for the results of the outcome study before deciding to go ahead with the economic evaluation. However, this overlooks the fact that the activities captured in this costing study represent the essence of community interventions and one would not be fully evaluating such interventions without examining the nature of the daily events and resource changes that the intervention brought about. Our inclusion of additional codes in the event logs purely for costing purposes did not add unduly to the workload required to collect the data and our experiences suggest it was feasible to do so. Importantly, this was also seen by the CDOs as a valuable activity as it validated much of their day-to-day work.

Finally, we should note that some elements of what the economists on the EcoPRISM team defined as costs, the CDOs regarded as the outcomes or benefits of their actions. We refer to the additional resources that were attracted to the intervention by successful community action. Even by our most conservative estimate, that is excluding the value of the vouchers donated by local businesses, the CDOs’ actions attracted additional resources to maternal health worth between 11 and 19% of the initial investment in PRISM. That is, for every $10 of public funds invested in PRISM, the CDOs managed to attract an additional $1–2 worth of resources from the local community predominantly in the form of volunteered time or services. If we adopt a more liberal approach and include the vouchers at face value, then the CDOs attracted an additional $3 for every $1 invested. The different perspectives on whether these resources reflect costs or benefits point to the need to take a macro or systems-level view of evaluation in community settings, seeing interventions not in isolation, as a linear process with the value of inputs being compared with the value of outputs, but instead tracking the recycling of resources around a community and reflecting on the value added at each stage [14].

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Conflict of interest statement

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References


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