Cost-Benefit Analysis of an Emergency Alarm and Response System: A Case Study of a Long-Term Care Program

Hirsch S. Ruchlin and John N. Morris

Cost-benefit analyses are routinely included in evaluations of acute care programs. In the case of long-term care, it is frequently alleged that cost-benefit analysis cannot be fruitfully applied. This article demonstrates the utility of applying cost-benefit analysis to evaluations of long-term care programs. A case study is presented in which cost-benefit analysis is used to evaluate an emergency alarm and response system developed to monitor the safety of vulnerable and disabled persons in their home environment.

It is widely recognized that current long-term care programs and policies are not meeting the needs of the population at risk. While increases in the proportion of elderly in the population are enlarging the demand for and the associated costs of long-term care services [1], publicly supported long-term care programs remain fragmented, difficult to access, inequitable in their coverage, and inconsistent in their use of social support networks. Federally subsidized long-term care programs foster an excessive reliance on costly medical and institution-based services [2,3]. There is an inadequate supply of accessible and affordable in-home and

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Address communications and requests for reprints to Hirsch S. Ruchlin, Professor of Economics in Public Health, Cornell University Medical College, New York, NY 10021. John N. Morris is Assistant Director of Social Gerontological Research, Hebrew Rehabilitation Center for Aged.

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community-based alternatives to long-term institutional placement. Relatively few mechanisms exist at the local level for managing and coordinating the wide range of social, health-related, and medical services that are needed by many of the functionally impaired [4,5]. It is clear that the resources allocated for long-term care are not being used efficiently, and that new approaches are required to deliver services to the elderly and the chronically ill and impaired.

In these times of cost consciousness, when the desire to provide more and better services must confront the limited ability of society to finance additional expenditures, one is naturally led to a cost-benefit criterion for resource allocation decisions. Policy analysts and researchers generally recognize the necessity for using cost-benefit analysis and are willing to apply this analytic tool to evaluations of acute care service programs [6,7]. Many are reluctant, however, to use cost-benefit analysis as a tool to guide policy making in long-term care and assert that other analytic techniques must be sought. It is our contention that cost-benefit analysis can be fruitfully applied in the long-term care field and, with all its recognized shortcomings, can be an objective and powerful evaluation tool.

This article is divided into two major sections. In the first section, we review the main arguments for and against the use of cost-benefit analysis in long-term care. We then present a general approach to the application of cost-benefit analysis to long-term care. In the second section, we present a case study using this methodology—an evaluation of an emergency alarm and response system.

Cost-Benefit Analysis and Program Evaluation

THE APPLICABILITY OF COST-BENEFIT STUDIES

Some policy analysts and gerontologists have suggested that the traditional techniques of economic analysis are out of place in research on long-term care [8–10]. The utility of cost-benefit analysis is dismissed because of the impossibility of assigning dollar values to many physical, medical, social, and psychological outcomes of long-term care. Further, quantifying program benefits in dollar terms poses special problems for geriatric health care evaluations: in most evaluations of health care programs, the majority of the economic benefits quantified result from additional productive man-years [11], and most elderly people have completed their economically productive years. The same problem holds with respect to the elderly afflicted with a debilitating chronic condition,

who will never be sufficiently rehabilitated to compete in the labor market.

The multiplicity of program objectives unique to long-term care severely limits a noneconomic quantification of program outcomes and dictates against conventional cost-effectiveness analysis. Measurement difficulties stem from the fact that most of the scales commonly used to assess outcomes utilize ordinal numbers, and ordinal numbers are nonadditive. Furthermore, no acceptable common denominator has been proposed for comparing and summing the outcomes of a multiple-goal program. To overcome these measurement problems, Doherty and Hicks propose a tabular display approach to the assessment of outcome [12], which allows for the multifaceted nature of health care and the complexity of individual programs. In this approach, prespecified criteria for program evaluation are presented as column headings and alternate programs as row headings. If the outcome criteria have been weighted, they can be arranged in order of decreasing importance, which allows one to recognize the more critical factors. This approach resembles a traditional cost-effectiveness analysis, but it expands the purview of such an analysis by enabling comparisons of both effectiveness and cost outcomes.

It appears that the tabular display approach is most useful in evaluations where alternate programs exist to achieve a stated goal. It is unclear how this approach would be used to evaluate a single program. Furthermore, as noted by its proponents, it is unlikely that a single program will emerge that is preferred on all prespecified criteria. Rather, one can expect to see two or three programs emerge for consideration. The choice of program must presumably be made on subjective grounds.

Even if one accepts the tabular display approach, or any other approach that avoids quantifying program benefits and leads to a cost-effectiveness analysis, one must recognize two drawbacks of the latter. First, it is generally considered to be less powerful and informative than cost-benefit analysis [6,7]. Second, and of much greater import, cost-effectiveness analysis can lead to the rejection of a program that yields no clear physical, psychosocial, or medical gain but does result in substantial resource savings from decreased use of expensive institutional and community services. Resource savings, which are a part of the benefit valuation in a cost-benefit analysis, are not part of an effectiveness valuation. Because of these drawbacks, efforts are needed to adapt the cost-benefit approach to evaluation of long-term care programs.

Although the inability to consider future labor-market productivity as a program outcome of long-term care poses severe problems for evaluating and choosing between programs targeted at working and nonworking populations, cost-benefit studies can still be undertaken *within* the long-term care sector, as long as this type of benefit is absent

from all the programs under consideration, as would be the case in evaluations of alternate long-term care programs. Cost-benefit studies not only permit interprogram comparisons but are equally suited to an evaluation of a single program.

Clearly, multifaceted program outcomes that are nonquantifiable from an economic perspective are ignored in cost-benefit studies, though at present there is no evidence to indicate whether nonquantifiable benefits are more meritorious than quantifiable ones. Research into ways of valuing nonquantifiable benefits is still in its early stages [13,14]. We do know, however, that insitutional care accounts for 92.1 percent of all expenditures for long-term care [15] and that adequate funding is not available to support the full range of services required in the long-term care sector [16]. Reduction of institutional care will be a major social benefit on numerous counts; chief among them will be an improvement in quality stemming from a reduction in inappropriate and excessive institutionalization, and the simultaneous freeing of scarce resources for use in alternative care modalities. The extent of the cost savings from these benefits is highlighted by the cost-benefit methodology proposed here. These savings are not captured by cost-effectiveness methodology. Hence it is our belief that cost-benefit analysis, which, with all its shortcomings and imperfections, does assess the magnitude of such savings, can make a definitive contribution to long-term care policy in an era characterized by complex decisions, difficult trade-offs, and limited resources, and that the results it produces are preferable to those generated by cost-effectiveness analysis.

A PROPOSED COST-BENEFIT METHODOLOGY

The cost of the program or intervention is the denominator in the benefit-cost ratio. No modifications are required in the standard economic methodology to estimate the cost of a long-term care program. Operating and capital costs are estimated for each designated cost center, and, if desired, an industrial engineering task-inventory approach can be used to disaggregate activity cost in a multi-activity setting [17–21]. This approach is particularly useful if one wishes to estimate program cost in different labor market settings or simulate cost under a series of stipulated program task modifications.

The numerator in the benefit-cost ratio, program benefit, is quantified by using a methodology proposed by Griffith [22]. This methodology involves comparison of alternate cash-flow streams resulting from the use of different combinations of resources. It is well suited to the evaluation of programs that use a less expensive array of services or economize on expensive resources. Griffith used this technique to esti-

mate the benefits of a home care program; Murphy and Datel [23] and Centerwall and Criqui [24] used it, respectively, in evaluations of community versus institutional living and efforts to prevent the Wernicke-Korsakoff syndrome. With this methodology, program benefit is equal to the dollar savings from expenditures avoided.

Use of this methodology to evaluate a long-term care program, *Lifeline*, is illustrated below.

Cost-Benefit Analysis of *Lifeline*

Description of the Program

Lifeline is an emergency alarm system developed by gerontologist Andrew S. Dibner. The system makes use of a novel electronic instrument to monitor the safety of vulnerable and disabled persons. The instrument is hooked up to the telephone and is capable of automatically dialing a 24-hour emergency station and identifying the user and the type of emergency. The system relies upon a timer that can be set by the owner at 12 or 24 hours (or less if desirable). The timer must be reset at least once during this time period by lifting the telephone receiver; this signals the *Lifeline* system that the person is well and active. If the timer is not reset, a buzzer sounds and an indicator light flashes in the home unit, and the unit automatically dials the 24-hour emergency station by means of an electronic signal. The emergency alarm may also be activated manually by means of a switch on the instrument or remote switches located in the bathroom, bedroom, or kitchen, or by a remote control device carried by the user.

When an emergency is signaled, the central operator at the emergency station phones the user. If there is no emergency, the user can press the reset button. If there is an emergency, or all is not well, the operator calls down a list of emergency responders (neighbors, relatives, friends, agency personnel, police, fire department) trained to get to the person quickly and reset the *Lifeline* alarm. The operator then transmits a reassurance signal to the *Lifeline* device that shuts down the local alarm and indicates by electronic beep to the stricken person that help is on the way.[1]

Study Design and Sample Characteristics

We hypothesized that *Lifeline*, by reducing anxiety about living alone because of fear of medical or environmental emergencies, and by motivating a person to extend himself or herself to perform normal activities

when alone at home, reduces the need for institutionalization and community support services. Further, physicians and family members would now support independent living on the part of the elderly or, if institutionalization were necessary, would suggest an earlier discharge date. Reducing institutionalization is widely held to be the primary need in long-term care [25].

To evaluate the *Lifeline* system, we first surveyed all medically vulnerable or functionally impaired elderly public-housing tenants in the Boston-Cambridge area living alone in apartments without built-in alarm systems. We then divided the sample into three target groups in order to evaluate the possible differential impact of the *Lifeline* system on populations with varying degrees of functional impairment and social isolation. Target group 1 consisted of the severely functionally impaired and socially isolated; target group 2 were the severely functionally impaired but not socially isolated; and target group 3 were the socially isolated and either moderately functionally impaired or medically vulnerable. Within each target group, subjects were randomly assigned to an experimental or a control group.

Unfortunately, as has been the general pattern in long-term care studies, a significant number of potential experimentals (about 30 percent) refused the offered service. We therefore modified the study design and based the evaluation on a sample of paired subjects *matched* from within the randomly allocated pools of experimentals and controls. The matching was done using both multivariate analysis of theoretically important variables and case-by-case selection by trained interdisciplinary clinicians [26]. The multivariate clustering procedure deliberately controlled for a number of demographic and client-vulnerability factors. This process yielded a matched sample of 139 experimental and control clients. Of the 139 pairs, 35 were judged to be in target group 1, 46 in target group 2, and 58 in target group 3.

In order to infer program impact, it is crucial that experimentals and controls exhibit pretest equivalency. We selected 99 variables as the basis for determining pretest equivalency; 64 were outcome measures and 35 reflected sociodemographic factors. Experimentals and controls differed significantly ($p \leqslant 0.05$) on only two outcome measures; in both instances, controls were better off. There were no significant differences for any of the sociodemographic variables. Similar comparability profiles emerged when experimentals and controls were compared within each of the three target groups. Given the very high degree of pretest comparability, and the fact that *Lifeline* was the only intervening factor not distributed equally among both groups, posttest differences are directly attributable to *Lifeline*.

The pertinent characteristics of the aggregate study sample are as

follows. About 30 percent of the sample members were over the age of 80, with an overall mean age of 75 years. The great majority were female (81 percent) and had previously been married (80 percent). Sixty percent of the sample classified themselves as Catholic, with about 25 percent Protestant and 12 percent Jewish. The racial composition reflects the composition of the Boston-Cambridge area: 85 percent of the study population were white, 14 percent black, and 1 percent other. At the time of pretest, 27 percent of the sample described their housing as poor, and 29 percent described their neighborhood as poor. Thirty-five percent described the services within their housing development as poor.

In line with the isolation stratification, target group 2, the only non-isolated group, exhibited stronger patterns of informal contacts and supports. For example, 59 percent of the people in target group 2, compared with about 36 percent of the people in the other two target groups, had children in the area. In addition, when asked whether their informal contacts could be counted on for meeting future needs, target group 2 members were almost twice as likely to answer in the affirmative (67 vs. about 35 percent).

Members of target groups 1 and 2 were more likely than members of target group 3 to have heart trouble (50 vs. 34 percent), neurological damage (20 vs. 9 percent), at least some trouble breathing (48 vs. 30 percent), dizziness (about 55 vs. 43 percent), poor self-reported health (about 30 vs. 10 percent), and a history of hospitalization in the previous two years (about 55 vs. 34 percent). Many more members of target groups 1 and 2 had limited capabilities than did members of target group 3. People in target groups 1 and 2 were less likely to be able to walk up and down stairs (36–50 percent vs. 5 percent) or walk half a mile (74–81 percent vs. 21 percent). There was also a greater incidence of the use of canes (about 50 vs. 24 percent) and walkers (20 vs. 1 percent). More individuals were judged clinically unable to do heavy work (about 95 vs. 71 percent) and were limited in the activities they could perform (about 90 vs. 61 percent). Many more believed that they would have at least some difficulty getting up were they to fall in their apartment (about 87 vs. 49 percent). These health and functional limitations were reflected in higher utilization rates for transportation (82 vs. 65 percent), shopping (about 86 vs. 32 percent), laundry (72–82 percent vs. 28 percent), and homemaking services (about 54 vs. 9 percent).

It is interesting that when assessed by nurse/social service clinical staff at the time of pretesting, target group 2 clients were judged to be more medically vulnerable than target group 1 clients. An assessment of the importance of available community services in preventing institutional placement revealed that without these services, 51 percent of target group 1 and 70 percent of target group 2 might be institutionalized.

PROGRAM BENEFITS

The service utilization patterns exhibited by the matched experimental-control sample form the basis for the benefit component of the cost-benefit analysis. We analyzed benefit profiles on two levels. First, we pooled all experimentals and controls into one large data base and analyzed study-wide benefit profiles. Second, we generated separate benefit profiles for each target group. Because we wish to demonstrate the adaptability of cost-benefit analysis to evaluation of long-term care programs, we present only the pooled profiles here. In the benefit-cost ratio section, however, we summarize differences in program benefit by target group. (A complete analysis of program impact by target group is presented in [27].)

Benefits attributable to the *Lifeline* program fall into three categories: direct savings from reduction in the use of health facilities and community services, program externalities, and nonmarket, or intangible, benefits.

We identified use of four types of institutional care as the basis for calculating direct savings: acute hospital, chronic and rehabilitation hospital, skilled nursing facility (SNF), and intermediate care nursing facility (ICF). (Mental hospitals and rest homes could also have been included in this listing had the sample members made use of such facilities.) We also identified the following community services as relevant to the population at risk: physician care, mental health care, social counseling, professional nursing care in the home, physical therapy, nutritional counseling, home health-aide care, homemaking services, meals-on-wheels, social agency friendly-visitor service, daily checking, and special transportation. We gathered data on the provision of these services from the study subjects. The data pertained to services provided by an agency or other formal provider and to services provided by friends, neighbors, and family (informal community support services). Differential utilization of these institutional and community resources by experimentals and controls formed the basis for our estimates of direct benefits. Intangible benefits, such as use of the *Lifeline* system to notify the police or fire department of crimes or fires in progress, and nonmonetary benefits resulting from enhanced personal security were excluded from the analysis because they cannot be quantified in dollar terms.

We used 1977 Massachusetts Medicaid rates as price proxies for institutional and formal community support services. In estimating the utilization costs of informal community support services, we used the prevailing minimum hourly wage rate, since these are primarily voluntary services involving unskilled labor. Our definition and measurement of units of formal and informal support services were guided by the expert

judgment of the clinical staff of the Department of Social Gerontological Research, Hebrew Rehabilitation Center for Aged.

A major expected program benefit was in the area of institutional and community days. Placement data for the 139 matched pairs over the 13-month impact period are reported in Table 1. With the exception of chronic and rehabilitation hospital days, controls used more days of institutional care than experimentals. In the case of both SNF and ICF nursing home care, the differential use pattern is quite dramatic. Controls used 10 times as much nursing home care as experimentals. In the aggregate, controls used 1,250 more institutional days than experimentals. As a result of this pattern, controls spent fewer days in a community setting than experimentals.

Table 1: Placement History during the Impact Period*

	Experimental		*Control*	
	Total Days	*Mean Days*	*Total Days*	*Mean Days*
Placement Location				
Acute Hospital†	944	6.79	998	7.18
Chronic and Rehabilitation Hospital	414	2.98	337	2.42
Nursing Home (SNF)†	67	0.48	714	5.14
Nursing Home (ICF)†	71	0.51	708	5.09
SUBTOTAL†	1,496	10.85	2,757	19.84
Community	53,713	386.42	52,452	377.35
TOTAL	55,209	397.18	55,209	397.18

*Number of pairs = 139

†Differences significant at the 0.05 level or lower.

Greater use of institutional care should lead to larger expenditures. This is borne out by the cost data reported in Table 2. In the aggregate, the placement profile of experimentals resulted in an estimated cost of $1,201,933.82, compared with an estimated cost of $1,227,239.21 for controls. We used Department of Labor data to estimate the average cost of a community day (see footnote to Table 2).

A second major expected benefit was in the area of community support services. Community service utilization histories were available for only 117 (or 84 percent) of the 139 matched pairs. For purposes of the benefit analysis, we decided to project the utilization data for the 139 pairs

Table 2: Cost of Placement

		Experimental		*Control*	
Placement	*Cost per Day*	*Days*	*Total Cost*	*Days*	*Total Cost*
Acute Hospital	$276.00	944	$260,544.00	988	$275,448.00
Chronic and Rehabilitation Hospital	98.45	414	40,758.30	337	33,177.65
Nursing Home (SNF)	36.86	67	2,469.62	714	26,318.04
Nursing Home (ICF)	23.83	71	1,691.93	708	16,871.64
Community	16.69*	53,713	896,469.97	52,452	875,423.88
		TOTAL	$1,201,933.82		$1,227,239.21

*Based on an intermediate budget for a retired couple, autumn 1977, living in Boston [28]. All budget items except medical care are included in the current calculation. Housing cost was utilized as reported. Food, personal care, other family consumption, and other items were divided by 2 and multiplied by 1.2. Transportation and clothing costs were divided by 2. The annual estimated budget of $6,090.30 was divided by 365 to obtain a daily cost estimate.

on the basis of data for the 117 pairs, because the latter constitute a large proportion of the total sample, and what is more important, we were able to verify the assumption that the projected cases would be similar to the actual ones. We collected data for 12 categories of formal community support services (see Table 3). Experimentals used formal community support services more often than controls in 4 of the 12 categories (physician care, mental health care, home health care, and transportation). In all cases, mean differences in utilization were not statistically significant at conventional levels.

The cost of formal community support services used by experimentals and controls is reported in Table 4. For this category, cost of services used by controls exceeded that of experimentals ($217,987.96 vs. $197,228.68). This result is based on the experience of 117 pairs. The cost estimates for the assumed study population of 139 pairs were $234,314.38 for experimentals and $258,977.11 for controls, indicating that controls consumed $24,662.73 more services than did experimentals.

Utilization patterns for informal community support services—services provided voluntarily by relatives, friends, or neighbors—are reported in Table 5. Respondents reported using only five informal support services. With the exception of transportation, controls used more informal support services, although the means were significantly different only for daily checking. The cost of informal community support service use is reported in Table 6. Controls used $26,523.13 worth of informal support services compared with $15,987.27 for experimentals. Adjusted to the level of 139 pairs, the figures are $18,993.42 for experimentals and $31,509.48 for controls, yielding a benefit of $12,516.06.

Table 3: Units of Formal Community Support Services Utilized during Impact Period*

		Experimental		Control	
Service	*Units*	*Total*	*Mean*	*Total*	*Mean*
Physician Care	Visit	984	8.41	885	7.56
Mental Health Care	Visit	2	0.02	0	—
Social Counseling	Visit	361	3.09	424	3.62
Professional Nursing Care in the Home	Visit	540	4.62	568	4.85
Physical Therapy	Visit	44	0.38	104	0.89
Nutritional Counseling	Visit	2	0.02	7	0.06
Home Health-Aide Care	Four-Hour Visit	957	8.18	132	1.13
Homemaking Service	Four-Hour Visit	6,289	53.75	7,684	65.68
Meal Provision	One Meal	5,761	49.24	7,896	67.49
Friendly Visitor Service	Visit	64	0.55	241	2.06
Daily Checking	Daily Check	450	3.85	510	4.36
Transportation	Round Trip	1,344	11.49	1,208	10.32

*None of the utilization differences were significant at the 0.05 level or lower.

Table 4: Cost of Formal Community Services

		Experimental		Control	
Service	*Cost per Unit*	*Units*	*Total Cost*	*Units*	*Total Cost*
Physician Care	$15.00	984	$ 14,760.00	885	$ 13,275.00
Mental Health Care	25.00	2	50.00	0	—
Social Counseling	16.66	361	6,014.26	424	7,063.84
Professional Nursing Care in the Home	22.50	540	12,150.00	568	12,780.00
Physical Therapy	17.00	44	748.00	104	1,768.00
Nutritional Counseling	8.32	2	16.64	7	58.24
Home Health-Aide Care	17.76	957	16,996.32	132	2,344.32
Homemaking Service	21.24	6,289	133,578.36	7,684	163,208.16
Meal Provision	2.00	5,761	11,522.00	7,896	15,792.00
Friendly Visitor Service	2.30	64	147.20	241	554.30
Daily Checking	0.23	450	103.50	510	117.30
Transportation	0.85	1,344	1,142.40	1,208	1,026.80
	Total (117 pairs)		$197,228.68		$217,987.96
	Estimated Total (139 pairs)		$234,314.38		$258,977.11

Table 5: Units of Informal Community Support Services Used during Impact Period*

Service	Experimental		Control		Duration Of Service
	Total	Mean	Total	Mean	
Supervision of Home Physical Therapy Program	0	—	28	0.24	½ hr.
Provision of Meals	2,403	20.54	2,713	23.19	½ hr.
Homemaking	1,158	9.90	2,143	18.32	4 hrs.
Daily Checking†	8,298	70.92	14,312	122.32	5 min.
Transportation	432	3.69	407	3.48	1 hr.

*Estimated by clinical staff of the Hebrew Rehabilitation Center For Aged (Boston).

†Significant at the 0.05 level.

Table 6: Cost of Informal Community Support Services

Service	Cost per Unit	Experimental		Control	
		Units	Total Cost	Units	Total Cost
Supervision of Home Physical Therapy Program	$1.15	0	—	28	$ 32.20
Provision of Meals	1.15	2,403	$ 2,763.45	2,713	3,119.95
Homemaking	9.20	1,158	10,653.62	2,143	19,715.60
Daily Checking	0.19	8,298	1,576.62	14,312	2,719.28
Transportation	2.30	432	993.60	407	936.10
	Total (117 pairs)		$15,987.27		$26,523.13
	Estimated Total (139 pairs)		$18,993.42		$31,509.48

Table 7: Estimated Combined Program Benefit for the 139 Matched Pairs

Area	Total Cost		Benefit
	Experimental	Control	
Placement Location	$1,201,933.82	$1,227,239.21	$25,305.39
Formal Community Support Services	234,314.38	258,977.11	24,662.73
Informal Community Support Services	18,993.42	31,509.48	12,516.06
TOTAL	$1,455,241.62	$1,517,725.80	$62,484.18

The data presented in Table 7 summarize the benefit calculations for the 139 matched pairs by combining placement, formal, and informal support benefits. Experimentals used $1,455,241.62 worth of resources, compared with $1,517,725.80 for controls. Thus, over a 13-month period, controls' resource consumption amounted to $62,484.18 more than the resource consumption of experimentals. This statistic reflects the level of "costs averted" attributable to *Lifeline*; as such, it is the measure of the economic benefit of *Lifeline*.

PROGRAM COST

Utilizing a task inventory cost methodology, and drawing upon actual program experience over a 32-month period (October 1975–May 1978), we estimated that the monthly cost per *Lifeline* user would be $24.97. This monthly cost statistic can be disaggregated into the following major cost components: administrative cost, $7.18; direct operating cost, $14.59; and equipment cost, $3.20. Experimentals were exposed to the *Lifeline* system for a total of 1,337 months. This represents an average exposure of 9.6 months during the 13-month impact period. Based on a monthly enrollee cost of $24.97, the total program cost extrapolated for the 139 experimentals in the matched sample is $33,384.89.

BENEFIT-COST RATIO

Dividing estimated program benefit ($62,484.18) by estimated program cost ($33,384.89) yields a benefit-cost ratio of 1.87.

When we conducted the cost-benefit analysis separately for each of the target groups, we found the program to be cost-beneficial only for target groups 2 and 3. In the case of target group 2, severely functionally impaired but not socially isolated, the benefit-cost ratio was 7.19. For target group 3, socially isolated and either moderately functionally impaired or medically vulnerable, the benefit-cost ratio was 1.27. These differences stem from greater (or lesser) savings in placement location (i.e., institutional vs. community living) than for the entire sample. There was no program benefit for target group 1, severely functionally impaired and socially isolated, because use of institutional care by experimentals in this group exceeded that of controls.

SUMMARY AND CONCLUSIONS

Our economic evaluation of the impact of an emergency alarm and response system, *Lifeline*, indicates that experimentals used fewer medical

and social support resources than did controls. Experimentals used significantly fewer acute hospital and nursing home days than did controls. While experimentals also had lower utilization rates for various community support services such as physical therapy, homemaking services, and meals provision, these differences were not statistically significant. The economic value of the reduced medical and social support resource utilization was estimated at $62,484.18. Contrasting this saving, which represents the economic benefit attributed to *Lifeline*, with the cost of the program, which was estimated at $33,383.89, yields a benefit-cost ratio of 1.87.

The *Lifeline* case study supports the thesis that cost-benefit analysis can be used to evaluate long-term care programs and services. Since the *Lifeline* program was evaluated for a 13-month period, cost and benefit streams were not discounted. Clearly, discounting is called for if the cost and benefit cash flows encompass a longer time period than the one adopted in this study. With this caveat, the methodology followed in this study is adaptable to all long-term care program evaluations. It can be used to evaluate new programs, new approaches to "packaging" long-term care services such as case management, and new efforts to regulate the delivery of care such as PSRO reviews [29].

Most long-term care program evaluations conducted to date fail to identify positive program effects. This is particularly true of evaluations focusing on community service programs. The results reported here mark a major departure from this trend, especially with regard to target group 2, for whom benefits exceed costs by a ratio of 7 to 1. No other interventions that could yield similar results have been formally proposed or rigorously evaluated. We conclude that the community service program we have shown to be cost-beneficial merits consideration as an important component of any service program targeted at the elderly and infirm.

In an era of recognized resource shortages, in which all programs must be justified in terms of costs, a cost-benefit evaluation of a long-term care program is preferable to a cost-effectiveness evaluation that does not recognize or measure resource savings. If a program appears to be worthwhile from a purely economic point of view, if alternate mechanisms for achieving comparable gains are not available, and if one is confident that the program does not harm the population at risk, then one need not look further at the host of intangible advantages of the program. This is so not because these benefits are unimportant, but because attaining these benefits in no way diminishes the pool of resources available for other programs. If, on the other hand, the program does not appear to be worthwhile from a purely economic standpoint, then decision makers must judge whether or not its net intangible advantages

are significant enough to offset the net economic loss. With information on the likely extent of that loss, they can judge how much the intangible benefits must be worth to make the project acceptable.

Sole reliance on a cost-effectiveness analysis could lead to a "type II" error; that is, a program that yielded clear economic benefits could be rejected if it did not also yield clear noneconomic benefits. The risk of this type of error is illustrated by the data emerging from the overall evaluation of the *Lifeline* program [27]. Of 67 noneconomic variables used to measure program effectiveness, there were as many instances of positive as of negative effects at the 0.05 probability level (7.5 percent of the 67 variables). These data do not clearly indicate whether the emergency alarm and response system merits further expansion; one would have to complete a subjective analysis based on the magnitudes of the noneconomic effects to make such a determination. The cost-benefit methodology presented here bypasses these problems, and one is not faced with the possibility of rejecting a program that has economic merit.

Note

1. Most emergency events reported through the *Lifeline* system are medically related. Based on the utilization history accumulated during this study, one can expect each *Lifeline* client to experience one medical emergency every two years.

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