# COST EFFECTIVENESS OF A PREVENTIVE PROGRAM IN RENAL DISEASE

LESLIE LIPWORTH

The practice of weighing the cost of preventive programs against the expected benefits is probably as old as prevention itself. The number of preventive programs has proliferated in the past few years and has forced a competition for limited funds. The need to set priorities for public health funding of such programs has, therefore, required a more detailed breakdown of both cost and benefit. For example, the benefits include the reductions in future mortality, hospitalization and sickness absenteeism resulting from the preventive program, each benefit being expressed in terms of dollars saved. The value of the reduction in the mortality of males is estimated from tables compiled by economists showing the average future productivity of males at various ages. Defining the value of a housewife is more difficult, however, and an arbitrary figure must be used. For this reason some program planners prefer to refer to the number of lives that will be saved and do not apply a monetary value.

Because of the lack of agreement about the effectiveness of most preventive procedures in renal disease, and because many intangibles among the benefits defy precise evaluation, one may well ask what purpose is served in attempting to calculate the cost-benefit of any program. Apart from assisting the setting of priority in health planning, cost-benefit analysis is important in understanding the law of diminishing returns in expanding programs. Contrary to folklore that expanded programs automatically provide greater benefits, an analysis of the cost-benefit of several hypothetical programs of varying sizes will indicate the point at which further expansion leads to diminishing benefits.

Also, costing may show how the timing of components of programs can be adjusted to reduce cost; this approach will be applied to a national preventive program described below.

In the case of renal disease, several types of benefit programs could be devised. However, little agreement has been reached on the medical benefits of any except the eradication of renal bacterial infection, so that is the area to be discussed in this report.

Certain assumptions must first be made. The following are from the Kidney Disease Program Analysis of the United States Dept. of Health, Education and Welfare.[1]

1. The incidence of bacteriuria is 20 per cent in hospital inpatients, six per cent in pregnant females, 15 per cent in diabetics and one per cent in schoolgirls.
2. A large national program would be associated with laboratory research into both etiology and therapy. Clinical studies would be done and, most important, long-term follow-up of certain patients to evaluate the program. The training of personnel and expansion of existing facilities would also add to the costs.
3. As a result of the program, a reduction in immediate mortality resulting from pyelonephritis can be expected from the earlier detection of this infection. This would be more likely among the older patients.
4. A 50 per cent reduction would be seen in the prevalence of bacteriuria among the screenees and a 65 per cent reduction in the number of days off work or school.
5. A long-term result of the program is that eventually 0.4 per cent of those with bacteriuria would be saved from renal failure. This in turn rests on the following assumptions. Five per cent of those with bacteriuria may develop significant urinary infection and approximately 40 per cent of these would eventually die in renal failure. Implementation of the program would reduce the incidence of renal failure caused in this way by 20 per cent. Multiplication of these proportions leads to the figure of 0.4 per cent.

Certain other assumptions are also made such as the cost of the screening test, diagnostic confirmation and antibiotic sensitivity tests, treatment and supportive education of hospital personnel. Where possible the results of studies were used in making these assumptions, but frequently it was necessary to resort to "informed medical opinion."

TABLE I. HYPOTHETICAL NATIONAL SCREENING PROGRAM FOR BACTERIURIA

| | *Population Screened in One Year** | |
|---|---|---|
| | *All Hospital Inpatients, Prenatal Females, Nonhospitalized Diabetics in U. S.* | *All Hospital Inpatients, Prenatal Females, Nonhospitalized Diabetics and 30% of Schoolgirls Aged 6–9 Years in U. S.* |
| Total persons screened | 36,066,000 | 38,586,000 |
| Number with bacteriuria | 6,462,000 | 6,487,000 |
| Total cost | $158,265,000 | $174,252,000 |
| Cost to H. E. W. | $9,203,000 | $20,179,000** |
| Cumulative long-term benefits | | |
| Persons saved from renal failure (0.4% of those with bacteriuria) | 25,850 | 26,190 |

* The above figures were taken from the Kidney Disease Program Analysis.[1] The short-term benefits, including reductions in sickness days, are not shown in this table.

** The increase in cost to H. E. W. from $9,203,000 to $20,179,000, as a result of the addition of 30 per cent of United States females aged six to nine years, is in part caused by the expansion of facilities occasioned by the inclusion of these girls, costing $7,000,000.

From these assumptions, the Kidney Disease Program Analysis designed a hypothetical national screening program for bacteriuria. Several variations and levels of funding and scope of the program were examined but, of course, not all possibilities could be included. In this program, all hospital patients admitted in a single year in the United States, all pregnant females seen that year and all diabetics are to be screened (Table 1). This totals 36,000,000 persons of whom 6,500,000 have bacteriuria. The cost of such an extensive program to the Department of Health, Education and Welfare is $9,200,000. The number of lives eventually saved from death in end-stage uremia (0.4 per cent of those with bacteriuria) is 25,850.

When 2,500,000 girls, aged six to nine years, are added to those screened during the year, the number saved from uremia increases by only 340 to 26,190, whereas the cost increases from $9,200,000 to just over $20,000,000. This sharp decrease in savings exemplifies the law of diminishing returns. The major part of the increased cost of $10,800,000 was, in fact, the result of extra hospital, laboratory and screening facilities for the 2,500,000 girls. However, before dismissing the screening of schoolgirls as too costly for the benefits gained in a national program, consideration should be given to the possibility of extending the screening period from one to several years thus staggering

the load on many of the facilities. At the same time older, more cooperative female students may be screened instead of the six- to nine-year-old range.

The smaller community programs not mentioned in the national program have certain advantages that should be considered. Screening for bacteriuria can be added to other services in neighborhood health programs or school health programs. Thus, the necessary medical and administrative personnel may already be available. The epidemiologic follow-up could be part of the larger investigation. The community news media are willing and even keen to report and thus publicize programs with a local flavor.

As an example, consider bacteriuria screening of high school girls. The equipment required, consisting of a dip-slide with nutrient media and sterile bowl for collecting the urine, costs 44 cents per specimen collected. A school health-aide can obtain specimens from about 100 high school girls daily after instructing them on the correct manner of self-preparation. The slide is incubated and then can be read in seconds by comparison with a standard.

Taking into consideration the price of the equipment and the nursing aide's salary and travel expenses, the cost of screening is less than one dollar per screenee. The cost of screening 12,500 school girls who could be reached in this way would be as follows:

| | |
|---|---|
| Cost of screening tests<br>Number of positive for bacteriuria—137 | $11,000 |
| Cost of confirmatory tests<br>(137 × $7.50) | $ 1,028 |
| Cost of treatment at $30 per child<br>($10 for drugs and $20 for physician's services) | $ 4,110 |
| Total | $16,138 |

Cost of treatment is difficult to estimate in the case of kidney infection because of the presence of structural abnormality of the urinary tract in some patients.

The estimate of benefits for schoolgirl screening was made according to the method of the Research Triangle Institute.[2] They assume that 35 per cent of patients with bacteriuria have active pyelitis and half of these can be cured by the program. Expressed in dollars, the above program would save $130,000 in hospital expenses and $270,000 from

premature death, a total saving of $400,000. By comparison, total dollar benefit value from screening 12,500 pregnant females and for screening 12,500 infants are $1,900,000 and $1,000,000 respectively.

Another type of program would focus on patients with indwelling catheters, about ten per cent of hospital patients. The results of Martin and Bookrajian's study show that 33 patients died of gram negative bacteremia while being treated with a Foley type catheter in 1960 at the Jersey City Medical Center. A three-way catheter with rinse was made compulsory in the hospital in 1961, and the number dying of gram negative bacteremia after use of the indwelling catheter fell to five for 1962. If these results are applied to the United States, 40,000 deaths are being prevented or could be prevented annually by one of several types of the newer, inexpensive urinary drainage systems.[3]

An investigation to find which hospitals, if any, are still using the older method would again be of limited cost. It has been estimated that a kidney disease general education program would amount to only $140 for each hospital requiring instruction.[1] Without much further calculation, such an investigation, followed by education where needed, would be a worthwhile undertaking.

## REFERENCES

[1] Burton, B. T., Kidney Disease Program Analysis, Bethesda, United States Public Health Service Publication No. 1745, 1967.

[2] LeSourd, D. A., Fogel, M. E. and Johnston, D. R., Benefit-Cost Analysis of Kidney Disease Programs, North Carolina, Research Triangle Institute, 1968.

[3] Andriole, V. T., Preventing Catheter-Induced Urinary Tract Infections *Hospital Practice,* 3, 61, 1968.