Contemporary Themes

Benefits and costs of the schools' BCG vaccination programme

J A STILWELL

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Summary

By the mid-1980s the schools' BCG vaccination programme will be uneconomic. It is estimated that it will cost about £5500 to prevent one case of tuberculosis, the average total cost of which would be between £400 and £1300 depending on medical policy about the degree of illness for which hospital admission is necessary. In December 1975 the costs of the BCG programme were greater than its monetary benefits, probably by a factor of about 2.

Introduction

In almost every health authority in England BCG vaccination against tuberculosis is offered at about the age of 13 to all school children who, when tested, do not appear to have developed immunity and who do not show certain contraindications. The proportion of children who are found negative is high, and the take-up of the offer good. Of 565 500 children tested in England in 1972 88% were found to be negative, and 87% were vaccinated.[1] In Birmingham about 5% of children who are eligible for the scheme do not participate because of parental refusal.

BCG affords 80% protection against tuberculosis for 15 years.[2] Yet is the risk of infection large enough to make the BCG schools' programme worthwhile? This question may be answered by a technique which is commonly used both in the public and private sector to appraise investment decisions if it can be accepted that the costs of tuberculosis are the costs of treating it plus the value of the lost production which it causes during part of the treatment period. Or, if this cannot be accepted, then economic appraisal may show the net cost of a decision to make a certain reduction in morbidity.

Method

Estimates were made of: (*a*) the current (June 1975) cost of 100 000 BCG vaccinations, (*b*) the cost of a case of tuberculosis among the age group 14-28, and (*c*) the number of cases of tuberculosis saved in each of the next 15 years by 100 000 vaccinations now. By using a standard economic technique the value of the cases of tuberculosis saved in years to come was made comparable with the costs of the BCG programme now.

Using the same techniques, and making the same calculations for 100 000 vaccinations in every year from 1972 to 1985, a diagram was produced which showed the year when, on simple economic grounds, the BCG vaccination programme in its present all-embracing form became more expensive than it was worth and showed how the benefit: cost ratio deteriorates over time. Since all the figures on which these calculations were based are estimates derived in several different ways a sensitivity test was made. This showed how the overall results were altered by a 25% error in the estimate of the main variables entering the calculations.

The costs of treating a case of tuberculosis were based first on the admission rate for Birmingham notifications in this age group (14-28) for the years 1972-4. Since, however, there is presently a move to reduce hospital admissions for tuberculosis, and since this tendency will probably be especially strong for the age group under consideration, two alternative assumptions to the observed Birmingham admission rate have been made.

Costs of the schools' BCG vaccination programme

To estimate the resources in manpower and travelling devoted to the BCG schools' programme a survey was undertaken of 14 health districts, including Birmingham but otherwise chosen at random. The total number of vaccinations performed in these districts was 41 093, making this an 8% sample. The use by each district in 1974 of medical, nursing, and clerical manpower to carry out the programme was costed* and divided by the number of vaccinations.

The use of Heaf material and vaccine, the wear and tear on equipment, and the cost of disposables was estimated by dividing the total cost for the Birmingham programme for 1974-5 by the number of vaccinations in that period. No appreciable costs were incurred by the school or schoolchildren. The estimate of the cost per vaccination was £0·99, with an observed range of £0·50 to £1·45. The variance of the sample was such that the actual average cost over the whole country was almost certainly between £0·83 and £1·15. The estimated cost of 100 000 vaccinations was therefore £99 000.

Cost of tuberculosis in the 14-28 age group

BCG vaccination prevents tuberculosis. The costs which would have been caused had it not been prevented are, therefore, the benefits of the BCG programme. It is assumed that the schools' BCG programme does not reduce mortality. This implies that any cessation of the schools' programme should be accompanied by a greater selective programme in the immigrant communities at risk, sufficient to obviate any (small) increased chance of fatal illness.

Admission to hospital for men of working age is by far the most costly factor in treating tuberculosis, so the proportion of cases in the protected age group leading to hospital admission, and the length of that admission, are the most crucial statistics to determine. A survey of 430 new cases in the age group 15-29 notified in Birmingham in 1972, 1973, and 1974 was used as an estimator for both: 87% of notifications led to hospital admission, for a mean stay of 70 days. This estimated stay is consistent with Campbell's findings.[3]

Since admission rates may well fall in the future two separate assumptions were made as well as the estimates of current practice. These were that half the cases are admitted, and that no cases are admitted. In all, therefore, three separate estimates of the average cost of a case of tuberculosis in the relevant age group were made.

*All money costs in this paper have been brought to June 1975 levels.

Health Services Research Centre, Department of Social Medicine, University of Birmingham, Birmingham

J A STILWELL, MA, research fellow

Tuberculosis is not a particularly expensive condition in terms of hospital resources per bed-week. An average cost of £61 per bed-week was estimated, exclusive of drugs, on the basis of current costs of the most appropriate hospitals in the West Midlands Regional Health Authority. Slightly more costly is the lost production of workers—£69 a week for men and £39 for women. The drug regimen recommended by Springett[4] was costed at £264 a patient. It was necessary to make various other estimates of minor costs, and of such factors as the expected unemployment rate and cost of tuberculosis imputed to those still at school.* The estimates derived, for the average total cost of a case of tuberculosis for the age group 14-28, on the three hospital admission rates were: (*a*) 87% admitted, £1371 (*b*) 50% admitted, £892 and (*c*) none admitted, £398.

Cases saved by 100 000 vaccinations now

Fig 1 shows the estimated effect of 100 000 vaccinations in 1975 in terms of cases prevented in 1975 and each of the next 14 years. This figure is derived from the recent report of the Research Committee of the British Thoracic and Tuberculosis Association.[5] No account was taken in this report of the possible indirect benefits in terms of reducing the size of the infection pool by BCG—the risk of infection was assumed to be declining independently of the BCG programme. So no benefits were entered for preventing any cases which would, in the absence of BCG, have derived their infection from someone whose condition would itself have been prevented by BCG.† Nor were benefits entered for cases saved after 15 years, since by that time the number of cases saved would be very small and the benefits, when discounted (see next section), negligible.

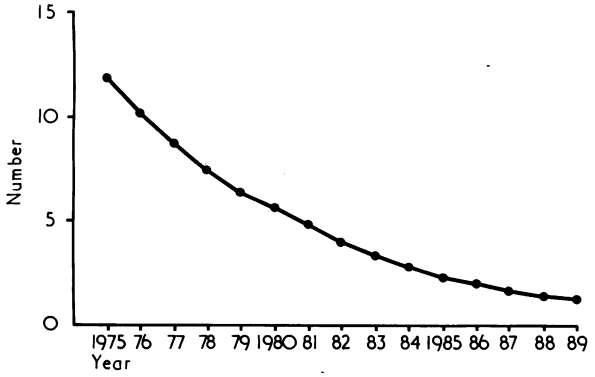

FIG 1—Estimated numbers of notifications prevented by 100 000 vaccinations in 1975.

Economic balance

In order to find whether the return on the current expenditure on the schools' BCG programme justifies its continuation it is necessary to make comparable the cost now of the BCG programme and future benefits in terms of avoiding the expense of treating cases of tuberculosis and their other costs. To do this the standard technique of investment appraisal called discounting may be used. This provides the information which a prudent bank manager would require to make a decision if he were asked for a loan to carry out the BCG programme and was promised that the future benefits would enable the loan to be paid off, with interest.‡ The table shows the relevant figures for this calculation on the assumption that 87% of cases are admitted. The entries under "benefits" are merely the cases saved, from fig 1, multiplied by the cost estimate of £1317. The discounting procedure shows that BCG is a "bad buy" to the tune of £29 000 per 100 000 vaccinations—that is, benefits equal only 71% of costs.

This discounting exercise was repeated for 100 000 vaccinations in each year from 1972 to 1985. Fig 2 shows costs as a multiple of benefit for the vaccination programme in each of these years. Each line on the figure corresponds to one of the three assumptions about the management of cases of tuberculosis in the future made in the section on the cost of tuberculosis. The A and B lines do not start before 1975 since they are based on hypothetical treatment programmes. (Because of the nature of this illustration the past indubitable benefits of the BCG programme do not appear.) By 1983, assuming that the costs of tuberculosis remain as high as they are now, the programme will cost five times as much as the benefits which it will yield.

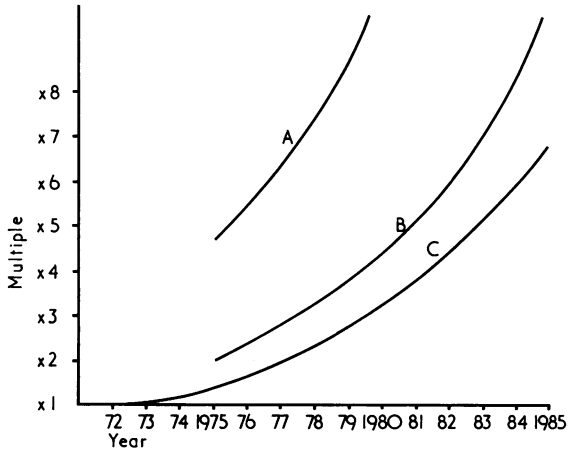

FIG 2—Projected costs of each year's vaccination programme as a multiple of capitalised benefits derived from that programme 1972-1985 with three different assumptions about management of tuberculosis: cost of case = (A) £398, (B) £892, and (C) £1317.

Sensitivity of economic balance

Since conclusions based on all assumptions so far have shown that the schools' BCG programme is, in economic terms, a "bad buy," an exercise was undertaken to show what difference would be made if each estimate and assumption were assumed to be incorrect by 25%, and if each error had been in the direction which would bias the conclusion against the schools' BCG programme. The result of this calculation (carried out only for the "current practice assumption" management of tuberculosis) was that the schools' BCG programme remains good value until 1977 but that by 1985 the costs are four times the benefits.

Discussion

By the early-mid 1980s each case of tuberculosis prevented by the schools' BCG programme will have cost about £5500—leaving an amount, net of the cost of illness, of about £4500. This

*A detailed list of all the estimates and assumptions used in this section of the work is available upon request from the author.

†A limited study was undertaken to try and investigate the realism of this assumption. From an examination of health visitors' notes on notifications over three months in 1974 in Birmingham no case could be identified where the probable source was in the protected age group. This at least produced no evidence to contradict the "independence" assumption.

‡The rate of interest to be used in such a calculation is the present public sector discounting rate of 10% (real).

Comparison between current cost of BCG programme and future benefits

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Cost of 100 000 BCG vaccinations (£)	99000														
Benefits from 100 000 BCG vaccinations in 1975 (£)	15803	13498	11523	9877	8560	7572	6585	5597	4938	3951	3292	2634	2370	2304	2238
Discounted benefits (£)	15803	12269	9517	7417	5846	4702	3714	2871	2093	1525	1270	921	756	668	588

would, for example, pay for two years' regular nursing surveillance of all the over-65s on an average general practitioner's list.[6] Nevertheless, even with such a poor economic cost:benefit ratio, it is still possible that decision makers might consider that the schools' BCG programme remains worthwhile in order to avoid the non-economic costs—such as the pain of illness—or in order to aim at eradicating the condition. The decision model is elaborately presented by Waaler and Rouillon.[7] In this case it is necessary to ask whether the schools' programme is cost effective, or whether the same or greater reduction in morbidity could be achieved more cheaply by alternative immunisation programmes.

A cheaper programme would be selective. Two factors should be considered. Firstly, the incidence of tuberculosis is much greater in immigrant communities.[8] Secondly, notifications of tuberculosis are clues which often lead to identifying and immunising groups of people who are at risk and sometimes lead directly to the source of infection or to other infectious cases. A positive reaction to a Heaf test at age 13 is a very poor clue, but the same may not be true of a test at 5.

Research designed to test the advantages of selective immunisation programmes, and considering the possibility of changing the age at which immunisation is offered, could yield results by the time when the present programme would be relatively so expensive that the health service would find it very difficult to justify its continuation.

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Problems of Childhood

Disobedience and violent behaviour in children: family pathology and family treatment—II

ARNON BENTOVIM

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The child of school age

Unlike the young child, who has a tendency to attribute all discomfort to others and blame them, the child when ready for school should have a sufficient sense of himself as a person to be able to distinguish clearly what he is responsible for and what he is not. He should have a reasonable conscience which guides his actions without needing constant reminding and which is not overstrict or too controlling, leading to passive behaviour—or defiance. He should have a reasonable ability to relate assertively to other children and adults—sharing, taking turns, and postponing gratification sufficiently to wait rather than to have what he wants immediately. These are all satisfactory conclusions to the preschool period. Epidemiological findings[1] indicate that disorders of emotion and behaviour are seen significantly during the preschool period when children are brought up in families where marriages are in difficulties, one or other parent has a psychiatric problem, particularly the very common depressive symptoms in mothers, and there are major social difficulties and breaks in caretaking by one or other parent.

Department of Psychological Medicine, Hospital for Sick Children, London WC1N 3JH
ARNON BENTOVIM, MB, FRCPSYCH, consultant psychiatrist

Marital separations and anomalous single parent upbringing also make the child's adjustment to starting school more precarious. The relationship with teachers and other children then has to carry the unresolved problems and crises from the earlier period. Similar factors—marital disturbance, family psychiatric and physical illness, parental separations, and social difficulties—are also seen in the families of children showing disturbance during the school age period.[2]

AGGRESSIVE BEHAVIOUR—ANTISOCIAL OR EMOTIONAL DISORDER

Characteristically children with antisocial difficulties are belligerent, uncooperative, and disobedient in family, school, and society. Such problems occur more often in boys, and the children are often restless at home and in class, impulsive, and attention-seeking and fail to exercise self-control in the face of provocation. Learning becomes difficult and may lead to poor educational achievement; a continuing sense of failure; and a need to gain status within the classroom or family by bullying and aggressive behaviour. A false sense of triumph is gained by putting down other children and teachers, but this may be accompanied by a feeling of emptiness, misery, and depression. Depending on the quality of parental control such problems may spread outside the family and school into society itself, with older children playing truant, stealing, or behaving in an aggressive and violent way towards property or other children and adults.

It is important to distinguish between children whose aggressive behaviour is part of an emotional disorder—that is, the child who is predominantly anxious, fearful, or depressed—