ILEP organisations should strive for high BCG coverage in communities at risk of leprosy

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Summary The central thesis of this paper is that the EPI policy of a BCG vaccination at birth or in the first year of life provides proven partial protection against leprosy and that ILEP organisations should actively encourage government health services to maintain a high coverage. A literature review identified 12 case-control studies showing a median vaccine efficacy of 63% (range 20–90%). Two prospective studies and two randomised community trials showed a median efficacy of 70% (range 42–80%). The duration of this partial protection is at least 10–15 years. Studies of the long-term protective effect of BCG vaccination against leprosy have not been conducted. One trial has demonstrated a reduction of tuberculosis incidence up to 40 years after vaccination with BCG. There is a growing consensus that BCG works by ‘upgrading’ the immune response to M. leprae, moving leprosy cases from the lepromatous end of the Ridley–Jopling classification to the tuberculoid end or even making it possible for infection to remain subclinical.

An analysis of national BCG coverage figures as reported to WHO showed that the global mean coverage increased from 58% in 1980 to 88% in 2003. The absolute number of countries reporting less than 80% coverage has decreased from 78 out of 105 in 1981 to 32 of 157 in 2003. Only four countries reported coverages below 60% in 2003. Twenty of the 53 African countries reported coverages below 80% in 2003 against five of 38 countries in Asia, five of 13 countries in Oceania and two of 27 in Central and South America. Comparison of officially reported national coverage to estimates of coverage from special surveys clearly shows that the national figure may not adequately reflect the local situation. Rural communities often have lower coverage than urban populations. Slum households have lower coverage than non-slum households. Remote areas may not be touched by modern health services. Pockets of low BCG coverage exist in countries where leprosy is endemic and ILEP organisations are active.

ILEP organisations can make an impact, not by getting involved in vaccination work directly, but by monitoring the BCG coverage and advocating for adequate provision of MCH services in the communities in which they work. This will reduce the risk of leprosy in children up to 15 years of age, provide a number of other benefits to the mothers and children involved and potentially contribute to a reduction of leprosy.
incidence on the longer term. If the partial protection imparted by BCG is life-long, adding a consistently high BCG coverage to the usual strategy of early case detection and treatment could result in a halving of the leprosy incidence in 2020.

**Introduction**

The central thesis of this paper is that the EPI policy of a BCG vaccination at birth or in the first year of life provides proven partial protection against leprosy and that therefore ILEP organisations should monitor BCG coverage in communities under their care and actively encourage government health services to maintain a high coverage.

Evidence is presented showing that a single BCG vaccination provides partial protection against leprosy. Secondly, an analysis of national BCG coverage data is presented and information on BCG-coverage at sub-national levels is quoted from the literature. We then discuss what impact may be expected from a high BCG coverage on leprosy indicators and how ILEP organisations might contribute to the realisation of a high BCG coverage in areas at risk for leprosy.

**Materials and methods**

**BCG AND LEPROSY**

We reviewed the literature for evidence associating exposure to a single dose of BCG during the first year of life (the usual EPI immunisation schedule) with occurrence of leprosy. Thus studies assessing the effect of multiple vaccinations with BCG or vaccination at later ages (including for household contacts) were excluded. Other leprosy vaccines were not considered, nor was immunotherapy with BCG.

Our review identified 12 case-control studies, two prospective studies and two randomised community trials. Vaccine efficacy was derived as (1-relative risk) and expressed as the estimated percentage reduction of leprosy incidence in the vaccinated relative to the unvaccinated. In case-control studies, the relative risk was estimated by the odds ratio.

For each case-control study, we deduced from the information provided in the paper (1) the year the national BCG vaccination programme started functioning, usually at first targeting children up to 15 years; (2) the year the programme was restricted to newborns and infants; (3) the year the data collection for the study was finalised; (4) the earliest possible year of birth of study subjects; and (5) the earliest year study subjects could have been diagnosed with leprosy. If any of these were not explicitly provided, they were estimated as closely as possible from the information presented.

**BCG COVERAGE DATA**

The World Health Organisation (WHO) published national BCG coverage figures (per cent of children under 1 year) for 157 countries over the 24-year period 1980–2003. Countries were categorised according to the level of BCG coverage in each year and the number of countries in each category presented. Average BCG coverage for each year was computed for all countries and for all countries of one continent and trend-lines plotted. Lastly, we
categorised countries according to the levels of child/adult mortality in 2003 as A (very low/very low), B (low/low), C (low/high), D (high/high) and E (high/very high) and considered trends in the distribution of countries over BCG coverage levels in each of these mortality-related categories. A number of high-income countries including Australia, New Zealand, Canada, the United States, the United Kingdom, Germany, Sweden and the Netherlands were not represented in this dataset.

Papers were collected from the literature which presented data on BCG coverage at sub-national levels such as health centres, villages, urban areas, districts or states, collected through special studies and surveys. We did not cite all the literature presenting such data, but focussed on instances where discrepancies were apparent between coverages reported through routine reporting systems and through special studies/surveys or where coverage differentials were reported between different areas surveyed.

Results

EFFECT OF SINGLE BCG VACCINATION AT BIRTH OR IN THE FIRST YEAR OF LIFE

Case-control studies

Twelve case-control studies almost all conducted in the 1990s (Table 1), showed a median vaccine efficacy of 63% (range 20–90%). In all these case-control studies, controls were matched to cases by age and sex; 11 research teams additionally matched by place of residence, while the 12th selected controls from schools located in the area where the cases lived; in seven studies controls were further matched by socio-economic status, place of birth, schooling status or ethnicity. In one study controls were matched to cases

<table>
<thead>
<tr>
<th>Country or State</th>
<th>First author, year [reference number]</th>
<th>Age at time of study (years)</th>
<th>%VE (95% Conf. Int.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-control studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Lombardi, 1996 [8]</td>
<td>&lt;16</td>
<td>90 (78–96)</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>Zodpey, 2005 [12]</td>
<td>≥20</td>
<td>61 (43–74)</td>
</tr>
<tr>
<td>Prospective study</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malawi</td>
<td>Ponnighaus et al. 1992 [13,14]</td>
<td>&lt;15</td>
<td>65 (50–75)</td>
</tr>
<tr>
<td>Brazil</td>
<td>Cunha, 2004 [15]</td>
<td>&lt;19</td>
<td>75 (57–86)</td>
</tr>
<tr>
<td>Randomized trials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uganda</td>
<td>Stanley, 1981 [16]</td>
<td>0–4 years</td>
<td>80 (62–89)</td>
</tr>
<tr>
<td>Myanmar</td>
<td>Kyaw Lwin, 1985 [17]</td>
<td>&lt;1 year</td>
<td>42 (–)</td>
</tr>
</tbody>
</table>

*%VE = per cent vaccine efficacy.
for the presence or absence of a household contact with leprosy. Ten papers presented matched odds ratios, while two\textsuperscript{2,6} did not specifically take matching into account. Ten odds ratios were not further adjusted for other possible confounders, while in two studies the odds ratio was corrected for presence or absence of previous cases of leprosy in the household\textsuperscript{2,7} and/or PB/MB classification of leprosy.\textsuperscript{7} A 13th case-control study was conducted in Venezuela\textsuperscript{21} and reported a vaccine efficacy of 49\% for a single dose of BCG, but the ages at which subjects had been vaccinated could not be deduced from the information presented. A quarter of the cases in this study had received multiple vaccinations with BCG in accordance with the policies of the local leprosy control programme.

All of these studies were carried out in relatively young people, as they were based on routine vaccination programmes which were introduced in the 1960s at the earliest. In Figure 1, the timing of each study is compared to the development of the national BCG vaccination programme over time. The figure illustrates that only for three studies in Brazil,\textsuperscript{3} Indonesia\textsuperscript{7} and India,\textsuperscript{12} can it be confirmed that study subjects had been exposed to a single dose of BCG in the first year of life. In Vietnam the programme targeted both schoolchildren and newborns so that the proportion of study subjects exposed to BCG only in the first year of life increased over time. In all other case-control studies, some study subjects were born either before the vaccination started (notably in Africa) or when the programme was targeting a wider age range. Although all study subjects had been at risk of being vaccinated with BCG, we have to conclude that for some of them this risk only existed after the first year of life.

All vaccination programmes used the same dose of 0.05 ml in newborns and 0.1 ml in children and adults.

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**Figure 1.** Timing of case-control studies (solid lines) relative to evolution of vaccination programmes (dashed lines). For each study area, the dashed line begins when BCG was first introduced for children up to 15 years of age and ends in the year data collection was finalised. A mark identifies the year when BCG was restricted to only newborns and infants. The solid line situates the study subjects in time from the year the oldest persons in the study were born to the first possible date of diagnosis of leprosy and, again, the end of data collection.
Prospective studies

One prospective study was conducted in Malawi\textsuperscript{13,14} and included subjects of all ages. Leprosy incidence between 1979 and 1989 was compared between persons with or without a BCG scar. After exclusion of cases with uncertain diagnosis, the vaccine efficacy was 65\% (50\%–75\%), although this figure would have been slightly lower if the analysis had been restricted to individuals born after 1974 i.e. those most likely to have received BCG in the first year of life rather than at a later age.

In a prospective study in Manaus in the Brazilian Amazon,\textsuperscript{15} 112,744 school children aged 7–14 years were assessed for presence or absence of a single BCG scar and followed up for 3 years. Since all study subjects had been born after 1983, it was assumed that the BCG scars that were present in 84\% had resulted from vaccination at birth through the national immunisation programme. The incidence of leprosy was 75\% lower in the vaccinated than in the unvaccinated group. When looking back at the leprosy experience of these children over a period of 9 years before enrolment, the vaccine efficacy was only 41\%. The authors argue that the latter figure could have been underestimated due to preferential inclusion of vaccinated cases over unvaccinated cases into the historical cohort.

Community trials usually focussed on vaccination of leprosy household contacts of a wide age range\textsuperscript{16,17,22,23} or on repeated vaccination of study subjects with BCG.\textsuperscript{22,24,25}

In a community trial in Eastern Uganda\textsuperscript{16} begun in 1960, children who were contacts of known leprosy patients were enrolled; this included children under 1 year of age though many were older. After 8 years of follow-up, the leprosy incidence rate ratio of vaccinated to unvaccinated children enrolled at 0–4 years of age was 0.20, i.e. a vaccine efficacy of 80\%.

A community trial started in 1964 in Myanmar\textsuperscript{17} enrolled over 26,000 children aged 0–14 years, allocating half to vaccination with BCG. Overall, protective efficacy was 20\% after 14 years of follow-up. However, the effectiveness of one of the two batches of vaccine used was compromised and the overall vaccine efficacy for the other batch was 30\%. Among children vaccinated before their first birthday with a single dose of BCG from the more effective batch of vaccine, the protective efficacy was 42\%. Thus children vaccinated in the first year of life had greater benefit from BCG vaccination than children vaccinated later.

Thus two prospective studies\textsuperscript{13–15} and two randomised community trials\textsuperscript{16,17} (Table 1) showed a median efficacy of 65\% (range 42–80\%).

A community trial in South India\textsuperscript{26} specifically excluded infants from the trial as these were covered by the standard immunisation programme. More detailed data were presented by Tripathy et al.\textsuperscript{27} which showed a vaccine efficacy of 42\% for children aged 1–4 years at vaccination. It must be recognised that 52\% of these children had already been vaccinated through the standard immunisation programme and received the trial vaccination in addition.

Duration of the effect of BCG

Given the current published studies, it is impossible to make evidence-based statements on the long-term effect of BCG vaccination. The study in Uganda\textsuperscript{16} had a follow-up of 8 years and the data suggested a slightly lower efficacy in the fourth round of follow-up, although the data were too sparse to draw any conclusion. The study in Myanmar\textsuperscript{17} had a follow-up of 14 years and the protective effect of BCG waned slightly after 11 years, although it was impossible to say whether this was a true decline or just random fluctuation. The trial in South India\textsuperscript{26,27} had a follow-up of 15 years and the data suggested some waning of effect after 12.5
years. The prospective study in Brasil\textsuperscript{15} showed that protection did not change with age, again suggesting that the effect of BCG at birth was present for as long as the observation lasted, i.e. up to 18 years.

Unfortunately, most case-control studies allow only very approximate estimation of the interval between vaccination and diagnosis of leprosy as they are based on identification of BCG scars. It can be deduced from Figure 1 that for most studies this interval could not have exceeded 20 years. Estimation of vaccine efficacy by time since vaccination has never been attempted in a case-control study.

The only long-term follow-up of study subjects in a randomised trial of BCG\textsuperscript{28} concerned protection against tuberculosis and showed a vaccine efficacy of 62\% at 40 years after vaccination. Ages at vaccination varied from 1 month to 20 years.

\section*{Shift in the leprosy spectrum}

There is a growing consensus that BCG works by ‘upgrading’ the immune response to \textit{M. leprae} and moving leprosy cases from the lepromatous end of the Ridley–Jopling classification to the tuberculoid end or even enables infection to remain subclinical. The result of this is a greater protective efficacy in MB than in PB leprosy, as some potential PB cases are avoided while a number of potential MB cases shift to manifest themselves as PB cases. Many studies report a higher BCG vaccine efficacy against lepromatous forms of leprosy compared to non-lepromatous forms,\textsuperscript{2,6–8,10–15} confirming that such a shift may indeed take place, though some studies report a higher vaccine efficacy against non-lepromatous leprosy.\textsuperscript{4,5,9} No study is large enough to show whether these differences in vaccine efficacy are statistically significant. However, Zodpey \textit{et al.} showed in their studies a significant linear trend of increasing efficacy from PB to MB\textsuperscript{29} leprosy or from single lesion to PB to MB leprosy.\textsuperscript{12} Rodrigues\textsuperscript{3} re-formulated the question and asked whether the proportion of MB cases among vaccinated cases was different from the proportion of MB cases among unvaccinated cases. In her study, this was indeed observed: the MB proportion was

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{trend_BCG_coverage.png}
\caption{Trend of Global BCG coverage from 1980 to 2003.}
\end{figure}
significantly higher among the unvaccinated cases. Findings from the Myanmar trial similarly showed a higher proportion of MB cases among unvaccinated cases, although the difference was not significant.

**BCG Coverage**

**National BCG coverage data**

The World Health Organisation (WHO) published national BCG coverage figures (in percentages) for 157 countries over the 24-year period 1980–2003. Fifty-three countries were in Africa, 38 in Asia and 26 in Europe, 16 in Central America (including Mexico), 11 in South America and 13 in Oceania.

The number of countries reporting BCG coverage data increased from 77 in 1980 to 105 in 1981 and then up to 152 over the next 10 years (Figure 2). Even so, the absolute number of countries reporting less than 80% coverage has decreased from 78 in 1981 to 33 in 2003. Only four countries reported coverages below 60% in 2003 against 55 in 1981. Consistent with this, the average of all the coverage figures reported in 1 year increased from 58% in 1980 to 88% in 2003.

The mean BCG coverage increased over the 24-year period in all six continents (Figure 3). Time trends show consistently high coverage levels in Europe, impressive progress in Asia and the Americas. Mean BCG coverage in Oceania was already around 75% in 1980 and is above 85% at present, while in Africa mean coverage was below 60% in 1980 and has been between 78% and 83% since 1990, lower than in the other continents. Twenty of the 53 African countries reported a coverage below 80% against five of 38 countries in Asia, five of 13 countries in Oceania and two of 27 in Central and South America.

Grouping the countries into strata based on the levels of child/ adult mortality in 2003, (A: very low/very low, B: low/low, C: low/high, D: high/high, E: high/very high), all strata had mean coverage levels higher than 80% in 2003. However, mean coverage was consistently lower in strata characterised by high child mortality (strata D and E) throughout the 24-year period reviewed, despite the tremendous progress made, which is particularly visible in stratum D (Figure 4). In 2003, 80 of 89 countries with low child mortality (strata A,
B and C) had BCG coverages above 80% versus 44 of 68 countries with high child mortality. Of course, this association does not necessarily imply a direct causal relationship between BCG and childhood mortality. Rather, BCG acts as an indicator here for coverage of newborns by MCH services in general.

Local BCG coverage data

Table 2 presents coverage estimates as reported by governments to WHO and as obtained from special studies and surveys in districts, urban neighbourhoods, villages etc. Two national sample surveys in the Philippines, and in China showed BCG coverages 25% lower than the reported coverage. A similar survey in Western and mid-Western Nepal estimated 61% coverage against 83% officially reported. In India, which consistently reported coverages well over 90% from 1990 to 1999, family health surveys in 1998-1999 resulted in state-specific coverage estimates of less than 80% for 10 of 23 states, of less than 60% for seven states and of less than 50% for three states including Bihar.

Data from surveys in Iraq, Himachal Pradesh in North India, and Tamil Nadu in South India, show lower coverages in rural areas compared to urban areas. Extensive surveys in Dhaka, Bangladesh, showed lower coverages in slum households compared to non-slum households in a part of the city where health care was getting a lot of attention. Similarly, surveys in the city of Chennai, India, using lot quality assurance sampling randomly surveying 36 children aged 12-23 months in each division, concluded that the overall BCG coverage in 43 divisions was 97%, close to the national estimate of 99.8 per cent. However, in four divisions BCG coverage was estimated as below 80%. Populations in urban slums may not, like rural populations, be physically distant from health services but encounter other obstacles limiting accessibility such as high fees, long waiting times, or rejection by health staff.

A survey in a remote area in the mountains of northern Vietnam revealed BCG coverage of only 36%. Although the coverage was quickly improved, this example illustrates that some
Table 2. BCG coverage as reported to WHO and as estimated through special studies and surveys

<table>
<thead>
<tr>
<th>First author, year [reference number]</th>
<th>Country or state</th>
<th>National coverage (%)*</th>
<th>Area</th>
<th>Number/Definition</th>
<th>Local coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>al-Sheikh, 1999 [31]</td>
<td>Iraq</td>
<td>96</td>
<td>Tikrit City</td>
<td>3260/2–2 years</td>
<td>97</td>
</tr>
<tr>
<td>Vieira da Silva, 1997 [32]</td>
<td>Iraq</td>
<td>96</td>
<td>3 rural villages</td>
<td>3360/2–2 years</td>
<td>92</td>
</tr>
<tr>
<td>Perry, 1998 [33]</td>
<td>Iraq</td>
<td>96</td>
<td>Tikrit City</td>
<td>385/0–2 years</td>
<td>97</td>
</tr>
<tr>
<td>Perry, 1998 [34]</td>
<td>Iraq</td>
<td>96</td>
<td>Pau da Lima, Salvador</td>
<td>650/0-11 months</td>
<td>68</td>
</tr>
<tr>
<td>Perry, 1998 [34]</td>
<td>Bangladesh, 1994</td>
<td>95</td>
<td>Slums in Dhaka, Zone 3</td>
<td>651/12–23 months</td>
<td>78</td>
</tr>
<tr>
<td>Perry, 1998 [34]</td>
<td>Bangladesh, 1994</td>
<td>95</td>
<td>Slums in Dhaka, Zone 3</td>
<td>660/0-11 months</td>
<td>68</td>
</tr>
<tr>
<td>Qian, 1994 [36]</td>
<td>China, 1990</td>
<td>99</td>
<td>Nationwide sample survey</td>
<td>592/0–5 years</td>
<td>65</td>
</tr>
<tr>
<td>Acharya, 2000 [37]</td>
<td>Nepal, 1991</td>
<td>83</td>
<td>Western &amp; Mid-Western</td>
<td>592/0–5 years</td>
<td>61</td>
</tr>
<tr>
<td>Dhadwal, 1997 [38]</td>
<td>India, Himachal Pr.</td>
<td>&gt;95</td>
<td>Urban Shimla Hills</td>
<td>257/13–36 months</td>
<td>84</td>
</tr>
<tr>
<td>Balraj, 1993 [40]</td>
<td>India, 1988</td>
<td>97</td>
<td>12 towns in N Arcot Dist.</td>
<td>7300/12–23 months</td>
<td>26</td>
</tr>
<tr>
<td>Murthy, 1999 [42]</td>
<td>India, 1994</td>
<td>99</td>
<td>43 divisions of Madras</td>
<td>1548/23 months</td>
<td>4 divisions &lt;80%</td>
</tr>
</tbody>
</table>
areas may remain untouched by modern health interventions unless special attention is drawn to the situation.

Onta et al. in Nepal\textsuperscript{41} compared the number of children vaccinated in one year as recorded in the registers of health centres to the number in the official activity report of the health centre and of the district health office. They found that at each level the reported number of children that were vaccinated was higher than at the previous level. They explain that at every level there is pressure to report activity even if none occurred due to temporary problems or if reports from the lower level were not received. Targets are set by the higher level and workers at lower levels have to be seen to meet these targets if at all possible. Thus the district reported nearly one-third more immunised children for the year than could be verified in the registers.

Although many surveys report satisfactory BCG coverage e.g. in urban areas in Brazil,\textsuperscript{30,32} the data presented in Table 2 show that an officially reported high BCG coverage does not exclude the possibility that in a specific community such as a rural district or an urban neighbourhood the actual coverage is much lower. This phenomenon occurs in areas where leprosy is endemic and where ILEP organisations are active.

**Discussion**

The efficacy of BCG for the prevention of leprosy has been reviewed previously.\textsuperscript{44–47} However, the present review attempted to answer the more restricted question of the effect of a single dose of BCG administered at birth or during the first year of life. Very few epidemiological studies could be identified which considered exclusively this more restricted association. The four studies that did\textsuperscript{3,7,12,15} all showed vaccine efficacies of 60\% or higher.

Numerous reasons can be suggested for the fact that some studies have resulted in low vaccine efficacies. These include variations between the particular strains of vaccine used, problems with the administration of the vaccine, problems with the registration and follow-up of the vaccinated and unvaccinated in trials of long duration, problems in the reading of BCG scars as well as host factors and environmental factors such as for example differences in immune response, nutritional status and infections with micro organisms other than \textit{M. leprae}. It is also conceivable that there is variation in the strains of \textit{M. leprae} and that these are not all equally sensitive to BCG. Fine\textsuperscript{48} lists a number of factors affecting efficacy of BCG against tuberculosis and most of these would apply to leprosy as well.

All but one of the case-control studies and two prospective studies\textsuperscript{16,17} measured exposure to BCG through the presence or absence of a typical scar on the body. Zodpey \textit{et al.}\textsuperscript{10} accepted evidence of BCG vaccination from immunisation records and cards and seven of 131 cases (5.3\%) and 13 of 221 controls (5.8\%) had convincing evidence of vaccination in the absence of a scar. This suggests that misclassification is not differential between cases and controls. It is reasonable to think that these studies therefore slightly (i.e. by a few percentage points) underestimated the true protective effect since in some children the BCG scar does not persist.\textsuperscript{49,50}

Fine\textsuperscript{51} argues that the efficacy of BCG may vary according to the rate at which children are infected with other mycobacteria, of which there are many,\textsuperscript{52} which might provide some protection against \textit{M. leprae} in a way similar to BCG. In the case of tuberculosis, Fine\textsuperscript{51} suggests that the limited duration of the protective effect of BCG might be explained by a steadily increasing protection against \textit{M. tuberculosis} in the unvaccinated due to exposure by environmental mycobacteria.
Doubt has sometimes been expressed that BCG had any effect in India, mainly because of disappointing results in Tamil Nadu. More recent studies, however, have shown a good efficacy in Maharashtra.

Although the variations in protective efficacy of BCG can sometimes be perplexing, the evidence supports an overall protective efficacy of BCG against leprosy which in 12 of the 16 studies presented in Table 1 exceeded 50% (range 55–90%).

**Expected Impact**

Immunising newborns with BCG will give them a partial protection against leprosy for at least 10–15 years and perhaps longer. The first effect on leprosy indicators one could expect, therefore, is a reduction of the proportion of children among new cases. Given that in most leprosy control programmes the child ratio is less than 20%, this effect would only have small effects on the new case detection rate and the prevalence rate.

Only if the protection imparted by BCG could be assumed to continue beyond the childhood years would a noticeable reduction in incidence and prevalence be observed but this effect would come about only gradually as it’s full impact would only be seen 40 or 50 years after vaccination. Meima et al. attempted to predict leprosy incidence on the basis of mathematical models incorporating all that is presently known about the epidemiology of leprosy. A scenario assuming early case detection and chemotherapy plus BCG vaccination of infants from 1975 onwards and reaching a coverage of 95% in 1999, resulted in a leprosy incidence in 2020 which was 39% to 57% lower than a scenario assuming early detection and treatment but no effect of BCG vaccination. This very good result is based on the (partially proven) assumption that a single vaccination with BCG imparts a life-long, partial protection of 50%.

**What ILEP organisations can do**

Even if BCG coverage reported from the national level is satisfactory, this by no means implies that BCG coverage is high in the specific communities with which ILEP organisations are working, particularly if these are poor and marginalised population groups e.g. slum dwellers, ethnic minorities, people in remote areas etc. As argued above, one cannot automatically assume that provision of MCH services is adequate in communities with a reported high BCG coverage, simply because - as explained by Murthy et al. - the sample surveys used to estimate BCG coverage do not permit identification of ‘pockets’ of low coverage.

Staff of ILEP organisations are increasingly working with general health workers to eliminate leprosy. This interaction provides opportunities to draw attention to the BCG coverage in communities at high risk for leprosy. Monitoring the BCG coverage and speaking out for the need to provide general MCH services to communities where BCG coverage is low will contribute to a reduction of the risk of leprosy, particularly in children. In addition, this will help to reduce the risk of juvenile tuberculosis and will bring other benefits of MCH interventions such as antenatal care, vaccinations against other diseases, family planning etc. Where a dialogue has been established, training MCH workers to suspect and diagnose leprosy can open up an avenue for the detection of women with leprosy.

Thus without usurping the role of government health services or launching separate vaccination programmes, ILEP organisations can support general health services in carrying out their usual role in relation to vaccination of children. An example where support for the planning of immunisation activities helped to improve BCG coverage was reported from...
Cambodia. This will benefit the communities involved without being costly. Such a role clearly fits within the vision of ILEP organisations to work with governments to help eliminate leprosy. It also accords with a widely held view that BCG should be considered part of any strategy to control leprosy.

If BCG vaccination can provide long-term protection and thereby bring about an additional reduction of some 50% in the incidence of leprosy by 2020, then investing ourselves, in addition to our usual leprosy control activities, in ensuring a consistently high BCG coverage in the communities in which we work will be of immense value for the elimination of leprosy. If it is not true, we will at least have provided what protection we could to children up to 15 years of age. Either way, the advantages are sufficiently clear for ILEP organisations to take positive action and advocate for the right of every child to be vaccinated.

Acknowledgements

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Advocacy for BCG vaccination


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