Trends in prevalence and case finding in the ALERT leprosy control programme, 1979–1999

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Summary  From 1979 to 1999, the ALERT leprosy control programme has covered a well-defined area in central Ethiopia using standardized case finding strategies. During this period, the leprosy prevalence has decreased more than 30-fold, there has been a 3-fold decrease in case detection and a 6-fold decrease in the case detection rate. The proportion of MB patients among new cases increased by around 80% and the proportion of children among new cases decreased by around 60%. Several factors may have contributed to these trends. The impact of the introduction of MDT and the shortening of the duration of the MB regimen are shown, but other factors are also discussed at length: an increase in the population of the area, cleaning up of the registers, changing case definitions, changes in staff motivation and fluctuations, even small ones, in case finding intensity and coverage. Do the observed trends reflect a reduction in the transmission of the leprosy infection? Because of the many confounding factors, it would be difficult to answer that question positively at present. Additional rigorous data collection and analysis is required.

Introduction

The interpretation of the recent trends in the leprosy endemicity is not easy. The prevalence of the disease is decreasing everywhere. Some take this as evidence that leprosy is being eliminated as a public health problem. Others argue that there has only been an impact on leprosy in the community if incidence goes down.

Several important changes in leprosy control strategies have occurred in recent years, not least being the introduction of multiple drug therapy (MDT). There also has been a move towards the integration of vertical leprosy services into the general health care services. These and other changes make the interpretation of leprosy control programme data less than straightforward. This is illustrated by the data set of the ALERT leprosy control programme. For 21 years, this programme has covered a defined area using standardized strategies.

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ALERT, the All Africa Leprosy, Tuberculosis and Rehabilitation Training Centre in Addis Ababa, Ethiopia, started as a hospital and training centre in 1965. Gradually, leprosy control activities were introduced. Initially, they were limited to the capital Addis Ababa. Over the years, rural zones were added one by one until the whole of the central province of Ethiopia (the then Shoa province) was covered. This represents an area of 86,576 km², where more than 70 experienced field workers ran almost 300 leprosy clinics.

From 1979 onwards, the area covered by the ALERT services remained unchanged, and standardized strategies for case finding, treatment and case holding were followed. As of January 1, 2000 the ALERT leprosy control programme has been discontinued and the responsibility for leprosy control has been taken over by the National Tuberculosis and Leprosy Control Programme.

The aim of this article is threefold:

- to present the prevalence and case finding data of the ALERT leprosy control programme for the period 1979–1999;
- to discuss the trends that can be observed; and
- to suggest a number of both epidemiological and operational factors that could have influenced those trends.

Materials and methods

The ALERT area has been covered in its totality and in a consistent manner by a vertical leprosy control programme since 1979. The majority of new leprosy cases (around 72%) were found through voluntary reporting. The specialized leprosy workers routinely performed contact tracing (contributing around 14% to case finding) and surveys in schools, prisons and factories (contributing around 2% to case finding). Around 12% of the new cases were referred by the general health services.

A diagnosis of leprosy was made if a person with suspect skin lesions was found to have loss of sensation in a skin lesion or an enlarged peripheral nerve trunk or a positive slit skin smear. Slit skin smears were taken routinely in all suspect cases. Biopsies were not part of the routine diagnostic procedures.

Treatment was prescribed by the leprosy workers based on standardized treatment protocols that, however, changed several times during the period (introduction of MDT, changes in classification criteria, changes in the duration of MDT). Treatment was administered by the leprosy workers in over 300 leprosy clinics and specially paid leprosy scouts were used to assist with case holding.

Extensive individual records were kept of all leprosy cases. Unfortunately these were never computerized, with the exception of selected patients enrolled in longitudinal studies. Although all records are still available and might contain a wealth of interesting information, it proved impossible to consult them for the purpose of this article. Instead, the ALERT Annual Reports were analysed to collect information on the prevalence of registered cases, the number of new cases detected, their age, classification and disability status, MDT coverage and treatment outcome. Other information that might be relevant to changes in the leprosy endemicity was also looked for. Only the reports covering the period of full area coverage 1979–1999 are considered.
Results

Table 1 presents the routine epidemiological indicators related to prevalence (i.e. cases registered for treatment at the end of the year) and case finding. Table 2 lists the proportion of MB patients and of children below 15 years of age among new cases. Table 3 presents some operational indicators related to MDT coverage and MDT completion. Additional indicators, for instance related to prevention of disabilities and treatment outcome, are available but will not be discussed in this paper. The disability rate of the new cases is not included because data are only available from, respectively, 1994 (WHO grade 2) and 1998 (WHO grade 1). This is too short a time period compared to the period covered in the article.

Discussion

TRENDS IN PREVALENCE AND CASE DETECTION

During 1979–1999, there was a marked increase in the population of the area, from 6.8 million to 13.6 million (Table 1). In spite of this, the absolute numbers of prevalent cases and new leprosy cases show a decreasing trend (Table 1). A variety of demographic changes
that have contributed to the population increase may also have had an impact on the leprosy endemicity:

- A birth rate that remains high while the death rate decreases.
- Immigration from the poorer peripheral regions to the more developed central region

### Table 2. Proportion of multibacillary (MB) patients and proportion of children among new cases in the ALERT leprosy control programme areas, 1983–1999

<table>
<thead>
<tr>
<th>Year</th>
<th>% of MB among new cases</th>
<th>% of children among new cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>43.00</td>
<td>Not available</td>
</tr>
<tr>
<td>1984</td>
<td>43.20</td>
<td>9.30</td>
</tr>
<tr>
<td>1985</td>
<td>43.40</td>
<td>9.50</td>
</tr>
<tr>
<td>1986</td>
<td>40.30</td>
<td>12.80</td>
</tr>
<tr>
<td>1987</td>
<td>44.40</td>
<td>9.50</td>
</tr>
<tr>
<td>1988</td>
<td>48.50</td>
<td>11.40</td>
</tr>
<tr>
<td>1989</td>
<td>51.50</td>
<td>10.70</td>
</tr>
<tr>
<td>1990</td>
<td>45.00</td>
<td>12.30</td>
</tr>
<tr>
<td>1991</td>
<td>51.40</td>
<td>8.10</td>
</tr>
<tr>
<td>1992</td>
<td>51.80</td>
<td>8.80</td>
</tr>
<tr>
<td>1993</td>
<td>52.30</td>
<td>9.50</td>
</tr>
<tr>
<td>1994</td>
<td>46.20</td>
<td>8.90</td>
</tr>
<tr>
<td>1995</td>
<td>49.70</td>
<td>13.40</td>
</tr>
<tr>
<td>1996</td>
<td>49.80</td>
<td>9.50</td>
</tr>
<tr>
<td>1997</td>
<td>53.40</td>
<td>6.00</td>
</tr>
<tr>
<td>1998</td>
<td>65.10</td>
<td>6.20</td>
</tr>
<tr>
<td>1999</td>
<td>75.30</td>
<td>5.00</td>
</tr>
</tbody>
</table>

### Table 3. Operational indicators related to MDT treatment in the ALERT leprosy control programme areas, 1982–1993

<table>
<thead>
<tr>
<th>Year</th>
<th>MDT coverage (%)</th>
<th>Cumulative number of patients who successfully completed MDT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total MB PB</td>
<td>Total MB PB</td>
</tr>
<tr>
<td>1982</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>1983</td>
<td>16.0 15.0 16.9</td>
<td>1296 0 1296</td>
</tr>
<tr>
<td>1984</td>
<td>19.7 25.2 16.9</td>
<td>1501 0 1501</td>
</tr>
<tr>
<td>1985</td>
<td>24.4 38.7 12.0</td>
<td>2341 669 1672</td>
</tr>
<tr>
<td>1986</td>
<td>39.8 54.2 23.6</td>
<td>2554 824 1730</td>
</tr>
<tr>
<td>1987</td>
<td>56.7 63.9 32.1</td>
<td>5127 1706 3421</td>
</tr>
<tr>
<td>1988</td>
<td>78.8 82.6 61.1</td>
<td>6046 1899 4147</td>
</tr>
<tr>
<td>1989</td>
<td>90.2 94.6 72.1</td>
<td>8800 3685 5115</td>
</tr>
<tr>
<td>1990</td>
<td>92.3 94.1 76.3</td>
<td>9780 4240 5540</td>
</tr>
<tr>
<td>1991</td>
<td>95.7 96.3 90.5</td>
<td>10,850 5132 5718</td>
</tr>
<tr>
<td>1992</td>
<td>99.7 99.7 99.6</td>
<td>11,646 5620 6026</td>
</tr>
<tr>
<td>1993</td>
<td>Not available</td>
<td>Not available</td>
</tr>
</tbody>
</table>
which has the additional attraction of the rapidly growing urban centre of Addis Ababa. This immigration was particularly pronounced during the famine of the early 1980s.

While the excess births will add leprosy free individuals to the population, immigration could have two opposing results:

- The immigrating population may have an excess proportion of leprosy patients, who hope for better living conditions in the city (begging, NGO charities).
- Leprosy patients are underrepresented. They are among the least favoured in society, and may have been the most severely affected by the famine, resulting in a higher mortality than the general population or being too weak to travel.

Some of the problems inherent in the raw leprosy numbers are avoided by presenting them as rates. Figure 1 presents the evolution of the prevalence and case finding rates in a single graph. Such a graph suggests that the prevalence rate has come down dramatically, while the case detection rate has remained fairly constant. However, there is a problem of scale. Since both rates are shown in the same graph, both are expressed per 10,000. This is too crude a scale to show any changes in the case detection rate. If the case detection rate is expressed per 100,000, as in Figure 2, we see a very different picture. This suggests that there was a marked decrease in the case detection rate as well (Figure 2).

FACTORS INFLUENCING PREVALENCE

The prevalence of leprosy in the area has come down tremendously, from a peak of 21,361 (25.71 per 10,000) in 1981 to an all-time low of 654 (0.48 per 10,000) in 1999. This is a 32-fold decrease of the prevalence and a 54-fold decrease of the prevalence rate. The main reason for this decrease would be the introduction of MDT, but several other factors may have contributed as well:

- Cleaning up the registers before introducing MDT.

![Figure 1. Evolution of prevalence and case detection rates in the ALERT leprosy control programme areas, 1979–1999.](image)
Reduced case finding activities.
Changing the definition of the prevalence rate.

Let us first look at the effects of the introduction of MDT. MDT was introduced in a small area in 1983 and gradually expanded to reach full coverage in 1993 (Table 3). During the introductory phase, the MDT effort concentrated on multibacillary (MB) patients. Figure 3 shows that in the years 1984–1985 the number of PB patients put on MDT stagnated while the number of MB patients put on MDT showed a constant increase. It is only in 1986 that the PB patients start catching up, but the gap is not closed until full coverage is reached. While this might have influenced the data during the initial years, this effect had diminished by the time all patients, both PB and MB, received MDT.

Initially, MB patients were treated until the skin smear became negative, with a minimum duration of 2 years. In 1987, a maximum duration of 5 years was set for MB treatment, even if the skin smear was still positive. In 1994, the 2-year fixed duration MDT regimen was
introduced for all MB patients. Finally in 1998, the duration of MB treatment was reduced to 1 year. Paucibacillary (PB) treatment has remained unchanged throughout: it is given for 6 months duration. (Single dose ROM regimen for single lesion PB cases has not been used in Ethiopia.)

The impact of MDT on prevalence started manifesting itself as early as 1983, when 1296 PB cases of the first cohort of patients put on MDT were released from treatment (Table 3). In 1985, the first MB cases (669 in number) were released from treatment. The rapid increase in number of patients released from treatment following MDT parallels the increase in MDT coverage.

Following the expansion of MDT coverage, the prevalence of leprosy in the area dropped spectacularly, from 21,338 (24 per 10,000) in 1982 to 2636 (2.3 per 10,000) in 1990. This is a 10-fold reduction in 8 years. By 1989, most of the area was covered by MDT, and from 1990 onwards, the prevalence reached a steady state, where the number of cases added was balanced by the number of cases deleted. This changed in 1994, when the introduction of 2-year fixed duration MB therapy resulted in a sudden prevalence fall (by 35%). This happened because all MB patients who had already received more than 2 years of MDT were taken off treatment. Another major prevalence fall, of 46%, was observed in 1998 when all MB patients were switched to the 1-year regimen.

But MDT alone cannot explain the decrease in prevalence. Comparing the number of cases on treatment (i.e. the prevalence in Table 1) with the number of cases released from treatment following MDT in Table 3, it is clear that during the initial stage of MDT introduction, the reduction in case load far exceeds the decrease one would expect as a result of releasing cases from treatment following MDT.

This was the result of the cleaning up of the registers. Before introducing MDT in an area, all patients on record were thoroughly evaluated, according to strict guidelines,7 which sometimes even included a biopsy. Cases who were found to have disappeared, or deceased, or no longer presenting any clinical, bacteriological or histopathological evidence of the disease, were removed from the registers. This cleaning up of the registers started in 1983 and continued until 1988. Its effect was most manifest during the period 1984–1986, when the prevalence was reduced by 61%, from 19,576 at the end of 1983 to 7632 at the end of 1986. Since 1258 cases were released from treatment following MDT during 1984–1986, only 10-5% of the prevalence reduction is attributed to MDT.

Another factor that could influence prevalence would be a decrease in case detection activities. This can be due to a change in the leprosy case finding strategy, but it can also result from civil unrest. Insecurity will have a marked negative effect on case detection, and this in turn will result in a decreased prevalence 1–2 years later. Ethiopia went through a period of civil unrest in 1990–1991, and this is probably the explanation for the small dip observed in 1991. Fortunately, the period of insecurity did not last, and by 1992 the full area was covered again.

A change in the definition of the prevalence rate would also have an impact on the epidemiological data. This has not been the case at ALERT, but for example the following would affect prevalence rates:

- A programme that used to calculate period prevalence (usually over a period of 1 calendar year) and switches to point prevalence (i.e. prevalence on 31 December)
- A programme that previously included cases requiring care after cure in its prevalence
figures, but then switches to the WHO case definition (i.e. patients who have yet to complete a full course of leprosy treatment)

- WHO has recommended replacing one of the cardinal signs of leprosy (enlarged nerves) by another (evidence of peripheral nerve function impairment). This may result in either fewer or more cases diagnosed, which in turn will affect the prevalence.

FACTORS INFLUENCING CASE DETECTION

When MDT was launched, its immediate objective was to overcome the very serious problem of dapsone resistance. It was hoped, however, that the bactericidal effect of rifampicin would decrease the reservoir of infection in the community, thus reducing transmission and resulting over time in a decrease of the number of new cases. Is this reflected in the case detection data of the ALERT programme?

The figures in Table 1 show that the case detection was decreasing rapidly well before there could have been any MDT effect. This phenomenon can be explained by the changes in area coverage of the ALERT leprosy control programme. This coverage only reached 100% in 1979. In the newly covered areas, it was inevitable that there would be many backlog cases, who were gradually detected during the initial years of full coverage. This probably explains the case detection peak during the first couple of years (1979–1981) in Figure 2.

As the number of backlog cases diminished, the case detection decreased correspondingly, to arrive at an equilibrium in 1986. The dip in 1985 can be explained by the severe drought affecting the Horn of Africa at that time, with the northern part of the ALERT area, where most leprosy cases are found, particularly hard stricken. Because of the resulting famine, leprosy case detection was temporarily pushed into the background.

From 1986 to 1988, the number of new cases remained constant. It is from this moment onwards that the effect of MDT on the transmission of leprosy should manifest itself. But when would this effect occur? If MDT does indeed reduce the reservoir of infection in the community, its full effect will not be manifest until all cases infected before the introduction of MDT have been detected. How long this will take depends on the incubation period of the disease. Since the incubation time of leprosy is very variable, some effect of MDT on the transmission of the disease could be observable within a few years after the introduction of MDT. The most useful approach would be to study consecutive birth cohorts longitudinally, as exposure to leprosy would decrease from year to year for each new birth cohort. Such an approach was used when analysing age and sex specific incidence rates in Norway during the period 1851 to 1920, but such data are not available for the ALERT leprosy control programme.

Does Figure 2 suggest that transmission is decreasing? The dip in the years 1990–1991 should be ignored as this was a period of insecurity, when several areas were inaccessible and the decreased coverage resulted in decreased case finding. The increase in 1992–1993 is then a backlog effect: the cases not found during 1990–1991 were detected after the situation returned to normal in 1992. Assuming that the backlog effect has worn out by 1994, one sees that the number of new cases has come down from 1006 in 1986 to 824 in 1989 and 723 in 1994. This decrease however does not continue. In fact, in 1995 case detection is up again, with 941 new cases. This was due to an increase in active case finding efforts: a special effort was being made to find as many hidden cases as possible.

By 1997, the case detection had come down again and continued to decrease in 1998 and 1999. But again there is a confounding factor here. Halfway through 1997, it was announced
that the ALERT Leprosy Control Programme would cease to exist and that all leprosy control activities would be taken over by the general health services by January 1, 2000. As a result of this announcement, many field staff lost interest in the programme. They looked for new jobs, enrolled in further studies or simply became demotivated. Thus the decrease in case detection from 1997 onwards probably reflects a decline in case finding interest of the staff rather than a reduction in transmission.

How can the ALERT case finding figures be interpreted? Case detection and case detection rate have decreased 3.5 times and 5.7 times, respectively. How much of this apparent decrease is real and can be attributed to MDT? How much is due to confounding factors? One of the strengths of the programme has been that the case definition has not changed throughout the whole period. But other factors did not remain constant. There has been the backlog effect following an increase in area coverage, there have been changes in coverage following civil unrest and in case finding efforts both positive (special campaign) and negative (famine situation, loss of interest of the staff). Such operational changes have had an undeniable effect on the epidemiological indicators.

FACTORS INFLUENCING THE PROPORTION OF MB PATIENTS AND OF CHILDREN AMONG NEWLY DETECTED CASES

If the transmission of leprosy is decreasing, one would expect an increase in the proportion of MB patients among new cases and a decrease in the proportion of children among new cases.

The increase in the proportion of MB patients is expected because it is assumed that the incubation period of PB leprosy is considerably shorter than that of MB. If MDT has an effect on the transmission of the infection, this would initially result in fewer PB cases, because the MB cases with their longer incubation time would have been infected before the effect was being felt. Thus, in the initial phase of reduced transmission, one would expect an increase in the proportion of MB cases among new cases. Such an increase can be observed in the ALERT data (see Figure 4).

But is Figure 4 really showing an impact of MDT on transmission? Most likely not! What we see is probably the effect of changes in the MB case definition. Problems associated
with changes in case definition were already mentioned in relation to prevalence and case
detection. The definition of a case of leprosy has not changed in the ALERT leprosy control
programme, but the MB case definition has changed several times:

- From 1979 to 1981, the ALERT leprosy control programme used the Madrid Classification
  (T-B-L).
- In 1982, the Ridley–Jopling classification (TT-BT-BB-BL-LL plus I) was introduced.
- In 1983, concurrently with the introduction of MDT, the PB-MB classification system was
  added in order to determine the treatment regimen. The criterion for MB was: a bacterial
  index of 2+ or more.
- In 1988, the MB criterion was changed to a positive skin smear.
- In 1998, the WHO recommended clinical criteria were adopted: MB if 6 or more lesions
  or less than 6 lesions with a positive skin smear.

These changes are clearly shown in Figure 4. There is a plateau from 1983 to 1987. In
1988, the proportion of MB begins to rise and remains at this higher level until 1997. The
high MB proportion consistently reported during this period is an epidemiological particu-
larity of the area. All MB cases were bacteriologically confirmed. In 1998, there is a sudden
increase following the introduction of the clinical criteria. Thus, the trend in the MB
proportion reflects the changes in MB case definition more than anything else.

If MDT does truly reduce transmission, this will manifest itself first in children.
Consecutive cohorts of children would be born into a situation of decreasing transmis-
sion, resulting in fewer infections and eventually fewer new cases. The ALERT data (Figure 5)
show a fluctuation between 8.1% and 13.4% between 1984 and 1996. These fluctuations
probably reflect changes in intensity of case finding. Often, children present less obvious
signs of the disease, and one has to look harder to find them. This might be further
accentuated by cultural factors. Children who are not acutely ill are commonly not taken
to the health centre.

It is probably more difficult to diagnose PB leprosy than MB leprosy. Thus in periods
of intensive case finding, when special attention is paid to finding difficult cases, one would
expect both a decrease in the proportion of MB and an increase in the proportion of children.
This can be seen in 1986 and 1990 (this was a year of reduced coverage, but the staff covered
the remaining area more intensively). The opposite happens in 1997. However, in 1995, a
year of intensive case finding, the proportion of children increases by 51% against the
previous year, but the proportion of MB did not go down. The effect of case finding intensity
is thus not clear-cut.

On the other hand, if the field workers are less interested in case finding, children will be
missed. It has already been explained that this has probably been the case at ALERT during
the last two and a half years of the programme. The obvious fall in the proportion of children
in the period 1997–1999 is most likely a result of this reduced motivation of the staff.

This again illustrates the importance of the impact of operational factors on the
epidemiological indicators. The same observation can be made when looking at the leprosy
trends 1979–1996 in the DBLM project in northern Bangladesh. In this project, trends that
were the reverse of those observed in the ALERT programme (increased case detection,
decreased MB proportion and stationary proportion of children) were clearly linked to
changes in coverage, case finding strategies and other programme factors.
In several other countries, the leprosy data have been analysed over a long time period. A decrease in the case detection rate, an increase in the MB proportion and a decrease in the proportion of children among new cases has been found in Myanmar\(^1\) (1958–1992), Thailand\(^2\) (1976–1990), Bhutan\(^3\) (1982–1992) and Malawi\(^4\) (1977–1991). While these trends suggest that the transmission of leprosy is decreasing, the respective authors give many alternative explanations based on operational programme factors.

It is should also be pointed out that in Thailand and Malawi, the case detection was decreasing well before the introduction of MDT. This is most elegantly illustrated in Malawi, where it is shown that the introduction of MDT did not accelerate the already prevailing trends. Possible explanations for this pre-MDT decrease in the leprosy endemicity could be: an efficient leprosy control programme in the dapsone era, socio-economic changes, and BCG vaccination.

**Conclusions**

The data sets mentioned above provide post-MDT trends over periods of 5, 7, 8, 11 and 12 years respectively. The ALERT data cover a 17-year post-MDT period. Even a follow-up period of such length does not allow one to conclude unambiguously that MDT does decrease the transmission of leprosy in the community.

It will be necessary to continue collecting data for several more years. In order to provide quality data, external reviews should document ascertainment methods and diagnostic criteria, and the data must be subject to critical and transparent analyses. Only then will we be able to concretely assess the true epidemiological trends of leprosy and the impact of MDT.

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References

6. ALERT Leprosy Control Division. *Annual Reports 1979 to 1999*. Available from: The Executive Director’s Secretary, ALERT, PO Box 165, Addis Ababa, Ethiopia.