An outbreak of African swine fever in the southern region of Malawi

R.M. EDELSTEN * and D.O. CHINOMBO **

Summary: An outbreak of African swine fever (ASF) was first detected in December 1989 in the southern region of Malawi. During 1990 the outbreak reached epidemic proportions: by August 1990, over 31,000 pigs (45%) from a population of 70,000 in the affected areas had died or been slaughtered. In affected villages this accounted for 83% of the pigs present.

The outbreak probably originated in the central region of Malawi, where ASF is enzootic. Virus isolates from the southern and central region outbreaks in 1989-1990 were indistinguishable using DNA restriction fragment pattern analysis.

The rapid spread of the disease and the difficulty experienced in halting this spread are discussed. Important factors included the type of pig husbandry (mainly scavenging without penning) and the fact that veterinary field staff lacked the mobility to ensure the observance of restrictions. New initiatives will be required – in particular, raising public awareness and developing community participation – if ASF is to be controlled in the future.

KEYWORDS: African swine fever – Control – Epidemiology – Malawi – Pig diseases.

INTRODUCTION

For many years, African swine fever (ASF) has been regarded as enzootic in the central region of Malawi, with sporadic epizootics occurring in the northern and southern regions.

The epidemiology of ASF in the central region has been described in some detail by Haresnape et al. (2, 4), who showed that ASF occurred in localised outbreaks each year, and that mortality in affected herds averaged 64%. Varying proportions of surviving pigs were seropositive and were regarded as carriers of ASF virus for several months after outbreaks had occurred. Haresnape and Mamu (3) reported that the tick Ornithodoros moubata was common in the central region, and ASF virus was isolated on several occasions from ticks originating from pig houses (5). These workers concluded that the endemic state of ASF in the central region was maintained by the presence of the vector tick and carrier pigs.

The first record of ASF in the southern region was made by Turnbull (10), who reported high mortality in an outbreak in the Blantyre and Chikwawa districts. The next
major epizootic in the region occurred in 1959, when Matson (6) recorded 12,000 deaths in a population of 19,000 pigs (63%). Subsequently, outbreaks of ASF were mentioned in the annual reports of the government Veterinary Department in 1962, 1965, 1969, 1971 and 1977, but details of the losses were not given. Small outbreaks were also confirmed in 1979 (in Blantyre) and 1983 (in Nsanje).

Haresnape et al. (2) concluded from their survey work that, in contrast to the central region, ASF was not endemic in the southern region. During epidemics, mortality in affected herds was usually near 100%, and only one seropositive animal was found in a survey of 278 pigs in areas which had a history of ASF. In addition, Haresnape and Mamu (3) had great difficulty finding *O. moubata* in the southern region. Despite an extensive search, the tick was found in only one pig house, three human dwellings and one warthog burrow.

In December 1989, after an apparent absence of six years in the southern region, ASF was confirmed as the cause of death in a sow near Mulanje. All ten pigs in the herd subsequently died, showing typical lesions of acute ASF. It rapidly became apparent that unreported disease activity had been occurring in the area for at least three months, and an investigation began immediately.

Over the next six months, the disease spread rapidly and devastated the pig population in the region. Although funds were not available to conduct a systematic investigation, various data were recorded at different stages of the outbreak. The data are presented in this paper, and the control of ASF is discussed.

**MATERIALS AND METHODS**

**Pig industry in Malawi**

The pig population of Malawi (as estimated by the annual livestock census of the Department of Animal Health and Industry) fluctuated between 200,000 and 250,000 in the years 1985-1989. The census of July 1989 recorded a population of approximately 87,000 village pigs and 3,600 commercial pigs in the southern region.

Village pigs are of indigenous African breed; they are black, or black with white patches, and are smaller than exotic breeds. The animals may be penned at night, while by day they scavenge for plants, crop residues and household scraps. In certain parts of the country, village pigs are never penned and scavenge over several square kilometres. Pens vary from simple enclosures, made of wooden poles, to mud-brick houses with thatched roofs.

Before the outbreak, the mean herd size in three areas where data were available was as follows (range in brackets) (D.O. Chinombo, unpublished findings, 1990):

- Chikwawa: 11.4 (1-118)
- Nsanje: 9.1 (1-117)
- Phalombe: 3.3 (1-12).

Commercial pigs are usually Landrace or Large White breeds or their crosses. Commercial feeds are available, but some producers mix their own feeds. Buildings vary from well-built brick-fired houses with cement floors, to houses which are similar to those in the villages.
Southern region of Malawi

The southern region is divided administratively into three agricultural development divisions, which are subdivided into rural development project areas (RDPs). Geographically, the region is divided into the Shire highlands (500-2,000 m) and the lower Shire (below 500 m), termed after the Shire river which runs through the region. The areas of the southern region are listed in Table I and are shown in Figure 1.

<table>
<thead>
<tr>
<th>Agricultural development division</th>
<th>Geographical description</th>
<th>Rural development project areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blantyre</td>
<td>Shire highlands</td>
<td>Blantyre *, Mulanje, Phalombe, Mwanza</td>
</tr>
<tr>
<td>Ngabu</td>
<td>Lower Shire</td>
<td>Nsanje, Chikwawa</td>
</tr>
<tr>
<td>Liwonde</td>
<td>Shire highlands</td>
<td>Zomba, Mangochi, Machinga</td>
</tr>
</tbody>
</table>

* covers the local government districts of Thyolo and Chiradzulu

Interview survey: January 1990

The four areas where ASF was suspected were visited by a veterinarian accompanied by the local veterinary assistant. Visits were made to all pig owners reporting disease activity typical of ASF, clinical and post-mortem examinations were performed, and pig population and mortality data were recorded.

Interview survey: August 1990

Questionnaires were posted to all fifty-three government veterinary assistants in the areas where ASF had been confirmed. Veterinary assistants are present at cattle dip tanks, and provide the basic veterinary services in these areas. Veterinary assistants interviewed all owners of pig herds where ASF had occurred, recording population data and deaths, and searching for soft ticks in affected kholas (pig houses). The presence of wild pigs in the area was also recorded.

Notifiable disease reports: September 1990 to December 1994

Data were abstracted from the notifiable disease reports made by veterinary assistants each month. The reporting system was newly established in August 1990. The data included numbers of sick and dead pigs.

Laboratory confirmation of disease

Smears of spleen and pieces of spleen and mesenteric lymph nodes from pigs which were suspected of having died from ASF were sent from various locations to the Central Veterinary Laboratory in Lilongwe, and were examined for ASF virus antigen by the direct fluorescent antibody test.

Spleen samples and whole blood in citrate anticoagulant were refrigerated and sent to the Institute for Animal Health (IAH) in Pirbright, United Kingdom, for detection of ASF virus using pig macrophage cultures. Strain characterisation was performed using DNA restriction fragment pattern analysis (8).
Post-outbreak serological survey in the lower Shire

A serological survey of surviving pigs was performed in villages in the lower Shire in April 1991, approximately six months after the ASF outbreak. Four diptank areas were visited. Only pigs older than six months were sampled. Blood was collected from the ear vein, and serum was stored at $-20^\circ$C prior to transportation. Sera were tested for anti-ASF virus antibodies by an indirect enzyme-linked immunosorbent assay (ELISA) (8) at the IAH.

RESULTS

Interview survey: January 1990

The first cases of ASF reported by veterinary staff occurred in December 1989 at Matambe village, 10 km south of Mulanje, on the Mozambique border (grid reference
35°30E, 16°05S). ASF was reported in four RDP areas, namely Blantyre (Thyolo district), Mulanje, Nsanje (northern half) and Chikwawa (southern half). A total of 2,714 pigs (63%) from a population of 4,304 had died in twenty affected villages. The affected areas are shown in Figure 1 and details of mortality are given in Figure 2.

**FIG. 2**

Deaths from African swine fever in the southern region of Malawi up to 31 January 1990, as a percentage of pig population in affected villages

Figures above the columns indicate the pig population in affected areas

Clinical signs recorded by veterinary officers included temperatures as high as 41.3°C, listlessness, staggering or swaying, collapse, cyanosis, diarrhoea and occasionally vomiting and dysentery. The most striking post-mortem lesions were widespread haemorrhages on serosal surfaces. The intestinal mucosa was usually inflamed and sometimes haemorrhagic. The spleen was usually (but not always) enlarged. Carcass lymph nodes were swollen and sometimes haemorrhagic.

**Interview survey: August 1990**

By August 1990, ASF had spread to all parts of the four RDP areas affected in January and was also affecting the Phalombe area (Fig. 1). Cases were reported in 28 of 51 diptank areas, in a total of 200 villages (Table II). The number of deaths attributed to ASF and mortality at RDP, diptank and village level are recorded in Figure 3. Interviewers experienced great difficulty in getting respondents to distinguish between death of pigs due to ASF, slaughter of sick pigs and slaughter of healthy pigs; the numbers recorded in Figure 3 therefore represent the total of these three categories. Of 70,000 pigs in the affected RDP areas, 31,384 (45%) had died; in affected diptank areas the loss represented 68% of the pig population, while in affected villages it accounted for 83% of the pigs present.

ASF affected ten commercial piggeries in the Blantyre area. Nine of these slaughtered all their pigs without undue delay. One herd of 441 Large White pigs owned by a parastatal company did not slaughter immediately, as the herd was in the process of being sold. Between February and August 1990, all but 40 pigs died. Of 32 survivors sampled, 30 were seropositive for anti-ASF virus antibodies. The remaining 40 pigs were then slaughtered.
TABLE II
Areas of the southern region of Malawi affected by African swine fever up to the end of August 1990

<table>
<thead>
<tr>
<th>RDP area</th>
<th>No. of diptank areas in RDP</th>
<th>No. of diptank areas affected</th>
<th>No. of villages affected</th>
<th>Name of affected diptank areas *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blantyre</td>
<td>20</td>
<td>5</td>
<td>14</td>
<td>Chiradzulu, Chilema, Bvumbe, Chisombezi, Nguludi, (Thyolo)</td>
</tr>
<tr>
<td>Mulanje</td>
<td>6</td>
<td>5</td>
<td>44</td>
<td>Khwalala, Chonde, Dulankhani, Dyanyama, (Muloza), Thuchila, Khancha, Mpasa</td>
</tr>
<tr>
<td>Phalombe</td>
<td>8</td>
<td>2</td>
<td>18</td>
<td>Khancha, Mpasa</td>
</tr>
<tr>
<td>Chikwawa</td>
<td>10</td>
<td>10</td>
<td>98</td>
<td>Kanjedza, Jombo, Mankhwira, Chilika, Maperera, Mthumba, Mwanawanjobvu, Ngabu, Tomali, Ndala, Khancha, Mpasa</td>
</tr>
<tr>
<td>Nsanje</td>
<td>7</td>
<td>6</td>
<td>26</td>
<td>Thundu, Bangula, Tengani, Nsanje, Chuluchamkango, Chimombo</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51</strong></td>
<td><strong>28</strong></td>
<td><strong>200</strong></td>
<td></td>
</tr>
</tbody>
</table>

RDP: rural development project

* brackets indicate areas where a government veterinary assistant is posted but where there is no diptank

No soft ticks were observed in any of the kholas examined by veterinary assistants. Six veterinary assistants reported that wild pigs were present in their areas.

**Notifiable disease reports: September 1990 to December 1994**

Between September 1990 and February 1991, ASF was confirmed at only one diptank, namely Ng’ong’ola near Phalombe. Deaths were recorded as follows: September (122), October (70), November (80), December (30), January (25), February (1). A total of 328 (79%) of 413 pigs in affected villages died. ASF was also confirmed at a small commercial piggery near Zomba in September 1990, where eight pigs died and the remaining 32 were slaughtered. In March 1991, two deaths were recorded near Thyolo in the Blantyre area. These were the last recorded cases of ASF in the Shire highlands until March 1993, when 34 pigs died in the Blantyre area. There has been a resurgence in 1995, with 609 deaths reported in the first four months of the year.

ASF re-emerged in the Nsanje area in March 1991, when three pigs died south of Bangula, followed by 51 deaths in June, 11 in July and 10 in November. There were no further reports of ASF until August 1992, when 15 pigs died near Ngabu. Confirmed cases of ASF have continued to occur in the Nsanje area, with 225 deaths in 1993, 265 deaths in 1994 and 902 deaths in the first half of 1995.

**Laboratory confirmation of disease and virus typing**

Between January and September 1990, ASF was confirmed by the direct fluorescent antibody test in 31 of 39 samples submitted to the Central Veterinary Laboratory in Lilongwe. The date on which ASF was first confirmed in an area and the origin of the samples are shown in Table III and Figure 1. The location and date of ASF outbreaks in the central region, which preceded the southern region outbreak, are also shown in Figure 1.
Deaths from African swine fever (ASF) in the southern region of Malawi up to 31 July 1990, expressed as a percentage of the pig population in each rural development project (RDP) area, affected diptank areas and affected villages.

Of the four blood and spleen samples sent to the IAH in Pirbright, one from Ndalapa diptank (Chikwawa area) and one from Thyolo (Blantyre area) gave positive results for the presence of ASF virus by tissue culture. Using DNA restriction fragment pattern analysis, both isolates were indistinguishable from isolates from the Lilongwe, Dedza and Ntcheu areas which had previously been examined by Sumption et al. (9). These all differed from the ‘Tengani’ virus isolated from a village near Nsanje in 1962 (1).

**TABLE III**

<table>
<thead>
<tr>
<th>Location</th>
<th>Rural development project area</th>
<th>Grid reference</th>
<th>Date ASF first confirmed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muloza</td>
<td>Mulanje</td>
<td>35°45E.16°05S</td>
<td>5.1.90</td>
</tr>
<tr>
<td>Bangula</td>
<td>Nsanje</td>
<td>35°05E.16°35S</td>
<td>1.2.90</td>
</tr>
<tr>
<td>Ndalapa</td>
<td>Chikwawa</td>
<td>34°55E.16°35S</td>
<td>8.2.90</td>
</tr>
<tr>
<td>Conforzi</td>
<td>Blantyre (Thyolo)</td>
<td>35°10E.16°00S</td>
<td>13.2.90</td>
</tr>
<tr>
<td>Nguludi</td>
<td>Blantyre (Chiradzulu)</td>
<td>35°10E.15°50S</td>
<td>14.2.90</td>
</tr>
<tr>
<td>Mpalanganga</td>
<td>Zomba</td>
<td>35°15E.15°25S</td>
<td>27.9.90</td>
</tr>
</tbody>
</table>
Serological survey in the lower Shire: April 1991

The results of the survey are recorded in Table IV. The pig population in the villages before the outbreak was 753: the total population in the villages when visited in April 1991 was 123. Fifty of the pigs were over six months old and were assumed to have survived the outbreak. Samples were taken from 43 of these pigs, and 35 (81%) gave positive results for anti-ASF virus antibody by ELISA.

<table>
<thead>
<tr>
<th>RDP area</th>
<th>Diptank area</th>
<th>Pig population in villages prior to the outbreak</th>
<th>No. of pigs present in April 1991</th>
<th>No. of pigs sampled</th>
<th>No. of pigs seropositive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chikwawa</td>
<td>Jombo</td>
<td>37</td>
<td>10</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Nsanje</td>
<td>Tengani</td>
<td>29</td>
<td>7</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Nsanje</td>
<td>Thundu</td>
<td>399</td>
<td>66</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Nsanje</td>
<td>Bangula</td>
<td>288</td>
<td>40</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>753</strong></td>
<td><strong>123</strong></td>
<td><strong>43</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>

**DISCUSSION**

Although the first report of ASF in this outbreak was made in December 1989, interviews with farmers in January 1990 suggested that the disease had already been active for at least three months (and perhaps as long as six months) prior to this first report, both in the Shire highlands and in the lower Shire. By the time the first investigation of the outbreak was made in January 1990, ASF was already widespread, confirming the suspicion that the disease had not been introduced recently. The clinical signs and post-mortem lesions recorded were typical of acute and peracute forms of ASF, as described by Neitz (7).

Virus typing suggested that the source of the virus for the southern region outbreak was most probably the central region of Malawi. ASF was active in the central region and spread gradually south during 1989 (Fig. 1). By September 1989, outbreaks were occurring in the Ntcheu area, less than 70 km from the boundary with the southern region. Movement of pigs and pig meat was not strictly controlled, and infection could easily have been carried south along the main road, towards Blantyre city, where the demand for pig meat is high.

No soft ticks were found by veterinary assistants in pig houses affected by ASF. This supports the view of Haresnape et al. (2) that O. moubata is probably not responsible for initiating outbreaks of ASF in the southern region. It was also unlikely that infection was introduced from neighbouring areas of Mozambique, as human and livestock populations had decreased to near zero following the prolonged guerilla war in Mozambique. Six veterinary assistants reported wild pigs in their areas; these were probably bush pigs (Potamocerus porcus) as this species is more common than warthogs (Phocochoems aethiopicus), which are rarely seen outside the national parks (2).
Although the number of bush pigs is quite small, they form a potential reservoir of ASF virus and would have to be taken into consideration if eradication of ASF was ever contemplated.

In January 1990, the southern region was officially designated an ASF-infected area and measures were taken – including a ban on the movement and sale of pigs and pig meat – in an attempt to prevent further spread of the disease. Road-blocks were set up to stop movement between areas; several small consignments of meat were seized and burnt. Radio announcements were made, advising pig owners on preventive measures. Slaughter of all pigs in affected villages was recommended, but a compulsory slaughter policy could not be enforced as there was no compensation. Due to financial constraints, Veterinary Department staff had severely limited mobility and were unable to enforce control measures: no prosecutions were made and mortality was high in affected villages, sometimes approaching 100%. However, it was difficult to define the geographical limits of villages and hence to determine the population at risk. It was also difficult to be certain how many pigs had died and how many had been slaughtered. For the same reasons, it proved impossible to calculate the true mortality for individual herds, but this reached 100% in a substantial number of herds.

The lower Shire areas were most strongly affected: there are few natural barriers to stop the spread of ASF in these areas and, more significantly, pigs are free-ranging and are rarely penned. Farmers admitted that they did not slaughter all surviving pigs as recommended, and that (where possible) they sold pigs to recover some money: they also delayed reporting ASF as they feared restrictions. ASF spread was more limited in the Shire highlands, but mortality was still high in affected villages. In these areas, penning of pigs and feeding of crop residues is practised more frequently, due to the high density of human inhabitants and crops; the economic situation of farmers is better in highland areas, and they were able to implement the recommended basic animal health measures.

By August 1990, ASF had killed so many pigs that the outbreak had almost come to a halt. Sporadic flare-ups of ASF continued, as not all the pigs in affected villages had been slaughtered. Although the outbreak was characterised by heavy losses, significant numbers of pigs either survived or escaped infection. The high proportion of pigs with anti-ASF virus serum antibodies in the lower Shire survey confirmed this. Some of the survivors were runts and had been affected quite severely by the disease, whereas others appeared to be relatively healthy. Although seropositive pigs are assumed to be carriers of ASF virus, it is not certain that they can transmit infection. Wilkinson (11) demonstrated viraemias in two pigs, eleven and twelve months after natural ASF infection, but transmission to in-contact susceptible pigs did not occur.

This outbreak of ASF reached epidemic proportions due to a combination of several factors. First, the traditional method of pig-keeping is free-range and scavenging. Second, the government Veterinary Department has insufficient resources to enforce the ban on movement and sales of pigs and meat. Third, pig farmers find the control measures too harsh. Enforced penning of pigs would be difficult to justify, as crop residues are scarce in many villages. A ban on free-ranging would effectively close down smallholder pig production. This measure would be socially unacceptable at present, as village pigs supply a significant quantity of animal protein for low levels of input. New initiatives are therefore required to tackle ASF, using measures which will be seen as positive by pig owners. Using extension services (farmer training), more emphasis should be given to increasing the role of the community in ASF control, particularly in preventing the introduction of ASF at the level of the village or the individual herd.
Early in outbreaks, emergency funds are essential to allow the Veterinary Department in the area to increase surveillance and implement effective extension. The main expenditure would be on extra staff ('veterinary scouts') and bicycles. Village livestock committees, which are traditionally oriented towards cattle production, should take on some responsibility for the control of diseases, in this case ASF. A system of penalties could be developed for application at the village level, rather than being imposed on individual owners. Offenders should be prosecuted early in the outbreak and the prosecutions should be widely publicised.

Less emphasis should be placed on total slaughter in villages. Instead, healthy breeding stock could be isolated early in outbreaks and survivors could subsequently be tested by ELISA; this test has recently been set up at the Central Veterinary Laboratory in Lilongwe. Seronegative animals could then be retained, and seropositive survivors culled. A study should be conducted to determine whether indigenous pigs with anti-ASF virus antibodies can transmit the virus, and what factors might precipitate such transmission.

Commercial pig-keeping zones should be set up (e.g. in Blantyre city), where stricter ASF control measures would apply. Free-range pig-keeping should be banned in such a zone, and movement of pigs and pig meat into the zone should be allowed by permit only. If ASF occurred in the zone, a policy of herd slaughter with compensation should be applied. The commercial pig industry might raise a levy to contribute to a compensation fund.

In contrast to the southern region, ASF is endemic in the central region due to the widespread presence of the tick *O. moubata*. The Veterinary Department cannot enforce restrictions on the movement of pigs and pig meat, as low-level outbreaks occur much of the time. There is no hope of eradicating ASF from the region in the foreseeable future, and efforts should therefore concentrate on preventing the spread of ASF virus from the central region to the non-endemic areas of the country. The most effective way of achieving this is by raising public awareness about the means of virus transmission and developing responsible attitudes at the community (village) level. Village committees would be encouraged to apply their own restrictions during outbreaks of ASF, with advice from the Veterinary Department on reducing the spread of disease within and especially between villages.

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UNE ÉPIDÉMIE DE PESTE PORCINE AFRICAINE DANS LE SUD DU MALAWI. - R.M. Edelsten et D.O. Chinombo.

Résumé : Un foyer de peste porcine africaine a été décelé en décembre 1989 dans le sud du Malawi. L’année suivante, la maladie avait pris les proportions d’une véritable épidémie : en août 1990, en effet, plus de 31 000 porcs (45 %) sur une population de 70 000 animaux étaient morts ou avaient été abattus dans les régions concernées. Dans certains villages, ce taux atteignait même 83 %.


La propagation rapide de la maladie et les difficultés rencontrées pour empêcher son extension font l’objet de la discussion. L’épidémie s’explique essentiellement par le type d’élevage pratiqué (en liberté et non en porcheries) et par le fait que le personnel vétérinaire de terrain n’était pas suffisamment mobile pour veiller au respect des réglementations sanitaires. Pour lutter efficacement contre la peste porcine africaine à l’avenir, de nouvelles mesures devront être prises visant notamment à sensibiliser les populations et à promouvoir leur participation.


UN BROTE DE PESTE PORCINA AFRICANA EN LA REGIÓN MERIDIONAL DE MALAUI. - R.M. Edelsten y D.O. Chinombo.

Resumen: En diciembre de 1989 se detectó un primer brote de peste porcina africana en la región sur de Malawi. En el curso del año 1990 dicho brote adquirió proporciones epidémicas: en agosto de aquel año, más de 31.000 cerdos (el 45%) de los 70.000 que componían la población de las áreas afectadas habían muerto o sido sacrificados. En los pueblos afectados, esta situación atañía a un 83% de los cerdos existentes.

El brote se originó probablemente en la región central de Malawi, donde la peste porcina africana es enzootica. Los aislados de virus recogidos en 1989-1990 a partir de los brotes de las regiones central y meridional eran indistinguibles entre sí por el análisis de sus respectivos patrones de fragmentos de restricción de ácido desoxirribonucleico (ADN).

En el artículo se comenta la rápida propagación de la enfermedad y las dificultades experimentadas para detenerla. Entre los factores más importantes se cuenta el sistema de crianza y explotación del cerdo (en libertad y no en explotaciones estabuladas), así como el hecho de que el personal veterinario de campo carecía de la movilidad necesaria para asegurar la observancia de las restricciones. Para que en el futuro pueda llegar a controlarse la enfermedad serán necesarias nuevas iniciativas. Es preciso, en especial, elevar el nivel de conciencia de las instituciones y fomentar la participación de la comunidad.
REFERENCES


