

EXPERIENCES IN THE CONTROL OF NEWCASTLE DISEASE IN MOZAMBIQUE

R.G. ALDERS, R. FRINGE, B.V. MATA
National Veterinary Research Institute,
Maputo, Mozambique

Abstract

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Activities associated with the investigation of Newcastle disease (ND) control in rural chickens in Mozambique are reviewed. The importance of collaboration with all stakeholders is emphasised, as is the collection of secondary documentation. Laboratory and field trials with thermostable ND are discussed. The development of appropriate extension packages, the role of community vaccinators and community livestock workers and establishment of cost-recovery procedures are outlined.

1. INTRODUCTION

Mozambique is an agricultural country, with 16 million inhabitants, 71% of whom live in rural areas [1]. In 1996, after fifteen years of war, Mozambique was considered by the World Bank to be the poorest country in the world with an annual income of 80 US dollars per person and a life expectancy of 46 years. In spite of the Rehabilitation Programme that improved the situation somewhat, two thirds of the population are still living in absolute poverty [2] and this situation has been seriously worsened by the recent devastating floods in the south of the country (in February/March, 2000).

Seventy percent of Mozambique is infested with tsetse fly, preventing cattle raising. Among smallholders, cattle are owned by approximately 45 000 families. In contrast, goats are owned by 327 000 families and village poultry by 2 000 000 families.

Village chicken raising, both for food, trade and ceremonial purposes, is traditional in rural areas and is generally the responsibility of women [3]. However, as in most other African countries, Newcastle disease (ND) is the most important production constraint, decimating up to 50 to 100% of birds annually [4, 5, 6]. ND vaccination campaigns have a vital role to play in the improvement of household food security and family income [4, 5, 6].

Three types of ND vaccine have been tested by the National Veterinary Research Institute (INIVE) in Mozambique: ITA-NEW, NDV4-HR [7] and I-2 [8]. ITA-NEW is an inactivated ND vaccine imported through a livestock project funded by the African Development Bank. The other two are thermostable, live ND vaccines whose testing has been supported by the Australian Centre for International Agricultural Research (ACIAR) ND Control Project [9]. The I-2 ND vaccine has been produced by INIVE for use in village chickens since 1999. Cost recovery mechanisms have been introduced to sustain I-2 ND vaccine production in the long term. In the short term, INIVE is receiving financial support from ACIAR and the International Fund for Agricultural Development (IFAD).

Initially investigations focussed on the testing of vaccines, but in order to develop a ND control strategy that could be sustainable in the long term, attention was also given to the development of appropriate extension packages, cost recovery and cost minimisation issues, linkages with other government agencies and non-governmental organisations (NGOs) and the encouragement of an enabling policy environment.

1.1. The importance of coordination and collaboration

In order to facilitate collaboration with key national agencies, a Poultry Working Group was established and consisted of representatives from the National Veterinary Research Institute, the National Directorate for Livestock, the National Directorate of Rural Extension (DNER), the Animal Production Institute, the Institute for Rural Development and the Veterinary Faculty. Strong links were also forged with the major NGOs working with village poultry, e.g. VetAID and World Vision.

1.2. Secondary data collection and baseline studies

Reports, articles and theses dealing with village poultry and ND in Mozambique were reviewed. Initial baseline surveys were developed in collaboration with the Poultry Working Group. Baseline

studies were completed in each area where thermostable live ND vaccines were to be tested. The study assisted with the collection of chicken population data and the definition of appropriate geographical locations for each of the treatment groups. The studies were based on a structured questionnaire that may be found in the ND field manual [10].

1.3. Vaccine laboratory and field trials

In many parts of Mozambique, the cold chain is weak or absent. Consequently, a strategy to control ND in rural areas must be based on the use of thermostable vaccine. While a comparison of the three best known thermostable ND vaccines can be made (Tables I and II), it was essential that the efficacy of the vaccines under Mozambican field conditions be determined.

TABLE I. COMPARISON OF THERMOSTABLE NEWCASTLE DISEASE VACCINES

Live vaccine	Inactivated vaccine
Contain a small amount of living virus which replicates; cheaper	Must contain a large amount of inactivated virus; more expensive
Can be administered by many routes: eye drop, intranasal, spray, drinking water, oral, injection	Must be injected
Stimulate all forms of immunity	Stimulate only antibody-based immunity
Duration of immunity varies according to route of administration, usually not more than 4 months	Duration of immunity approximately 6 months
Thermostability varies from 2 to 3 months for freeze-dried vaccine to 2 weeks for wet vaccine	Thermostable for 7 to 10 days
Not dangerous to vaccinator	Dangerous to vaccinator on accidental injection
Uniform dose for all ages of birds	Dose varies according to age of bird

Vaccine prices are given in American dollars in Table II. In the case of ITA-NEW and NDV4-HR vaccines, the importation of the vaccines would require sufficient foreign exchange to purchase the vaccine and transport it to Mozambique. In the case of I-2 vaccine produced locally, only a fraction of the production costs require foreign exchange.

TABLE II. COMPARISON OF COSTS ASSOCIATED WITH THERMOSTABLE NEWCASTLE DISEASE VACCINES

Vaccine	Type	Revaccination interval	Price per dose (US \$)*	Price per year per bird (US \$)
ITA-NEW (100 doses/vial)	Inactivated	6 months	0.0250	0.0500
NDV4-HR ** (100 doses/vial)	Live	4 months	0.0105	0.0315
NDV4-HR ** (1000 doses/vial)	Live	4 months	0.0015	0.0045
I-2 (INIVE) (250 doses/vial)	Live	4 months	0.0048	0.0144
I-2 (INIVE) (500 doses/vial)	Live	4 months	0.0030	0.0090
I-2 (INIVE) (1000 doses/vial)	Live	4 months	0.0018	0.0054

* Purchase price of vaccine, no transport costs included.

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2. MATERIALS AND METHODS

2.1. Laboratory trials with thermostable live ND vaccine

Each vaccine was initially tested under laboratory conditions in commercial birds. A local virulent challenge strain was used. Antibody levels were determined using the haemagglutination inhibition (HI) test [11]. Standard positive and negative sera were used in all HI tests.

2.2. Field trials with thermostable live ND vaccine

Following satisfactory laboratory trials, field trials with the thermostable, live ND vaccines NDV4-HR and I-2 were done over a two year-period. Extension activities with communities and training of community assistants commenced prior to the initiation of the trials [12].

The vaccine field trial protocols were developed in collaboration with the Poultry Working Group. The trials aimed to determine the best route of administration of the vaccine (whether eye drop, drinking water or oral drench) and the protection afforded by the vaccine against natural field challenge by local virulent strains of ND virus. Together with DNER, an attempt was made to identify vaccine field trial sites with functional extension networks.

In the NDV4-HR trial site, five months were devoted to extension activities and collection of data on village chicken production and husbandry. In the I-2 trial site, only two months were given to these start-up activities. During the pre-trial period, discussions were held with village chicken farmers to ensure that they understood the nature and importance of the trials (specific attention was given to the fact that a trial is different to a vaccination campaign) and to determine their willingness to participate. Treatment groups were allocated using a lottery system, in the presence of community representatives. Compensation for farmers whose chickens had the misfortune to be allocated to control groups was discussed prior to the initiation of the trials.

Assistants were selected from each community. Their role was to administer the baseline questionnaire, and monitor and record the number of chickens and the fate of individually numbered chickens in vaccinated and control groups over the trial period. In the NDV4-HR trial area, one community representative who demonstrated ongoing interest in trial activities during the pre-trial period and who possessed basic literacy skills was selected from each treatment group area. All assistants at this site were mature men. Payment for services rendered by the community assistant commenced at the start of the trial and was minimal. In the second trial area, following an example of similar work done in Sri Lanka, young women (18 to 20 years of age) just out of high school were selected by project staff to act as community assistants. Selection was based largely on their performance in a literacy and numeracy test. Once again, payment for services rendered by these women commenced at the start of the trial and was minimal.

In each trial area, overall organization of the community was done by the local secretary of the ruling political party. In some parts of Mozambique, such issues are dealt with by party representatives rather than traditional leaders.

The NDV4-HR trial consisted of four treatment groups each containing approximately 500 birds. Groups received vaccine via eye drop, oral drench or drinking water, and the control group was mock vaccinated. One drop of vaccine was administered to each bird every four months over a twelve month period. The I-2 trial also consisted of four treatment groups. The first group received vaccine via eye drop, one drop every four months. The second group also received the vaccine via eye drop, but the initial vaccination consisted of one drop of vaccine given on two occasions at an interval of 2 to 3 weeks. The third group also received an initial vaccination consisting of one drop of vaccine given on two occasions at an interval of 2 to 3 weeks, but vaccine was administered via drinking water. The fourth group was the control and received a mock vaccination. Revaccination was done at four-month intervals. Approximately 10% of chickens in each group were tagged with individually numbered wing tags. Monthly serum samples were collected from these birds to monitor serum antibody levels.

Community assistants recorded numbers of birds per household and the status of individually marked birds at two-weekly intervals. Project staff visited the sites each month and held a meeting with community representatives prior to commencing work in the field.

2.3. Field trials with thermostable inactivated ND vaccine

The ITA-NEW vaccine field trial ran over 8 months and the vaccine was administered by injection every six months.

2.4. Development of an appropriate extension package

Given that village poultry has received little attention, it was necessary to prepare extension material for all involved with the running of successful ND vaccination activities, i.e. from senior officials at the national level to provincial planners to front line extension workers and farmers. Initially, a series of seminars and workshops were held to present research findings and train government and NGO staff.

2.5. Community livestock workers and community vaccinators

Government veterinary and extension services in Mozambique are unable to provide cost-effective services such as routine vaccination to all local communities, especially those in remote areas. Therefore, community participation was recognised as crucial to the development of a sustainable program to control ND in village chickens.

The work of government veterinary and extension staff has been complemented at the village level in many developing countries by persons from the local community, the Community Livestock Workers (CLWs). A CLW is a man or a woman selected by the local community or appointed with their agreement to deal with animal health and production in the community [13]. The CLW is generally trained to deal with simple veterinary treatments for a number of livestock species.

In Mozambique, some NGOs have CLW training programs to which ND control has been added. In areas where no NGOs are working, selected poultry farmers who wish to learn how to vaccinate their chickens have been trained as community vaccinators by INIVE with assistance from ACIAR or IFAD. These same people may go on to become CLWs in the future. Once a complete ND control extension package has been developed, most of the training of community vaccinators and field staff will be done by the Directorate of Rural Extension.

2.6. Cost recovery and cost minimisation

The I-2 ND vaccine produced at INIVE is sold to users. The sale price of the I-2 vaccine sold by provincial veterinary services is increased slightly to cover transport costs. The ITA-NEW vaccine being used by the ADB project is also now sold. However, in some cases, projects purchase the I-2 ND vaccine and provide it free of charge to village chicken farmers in the first year.

The recommendation from the ACIAR/INIVE ND project was that farmers should always be encouraged to pay for the vaccine and the labour costs associated with its use.

3. RESULTS

3.1. Laboratory trials with thermostable live ND vaccine

Each vaccine provided absolute protection against challenge with the local strain, while control birds succumbed to challenge.

3.2. Field trials with thermostable live ND vaccine

At each trial site a natural outbreak of ND occurred and this was verified by the isolation of the ND virus from birds that succumbed to the disease within the trial areas.

The two trials ran for different lengths of time but in each case, a substantial increase in the chicken population was observed in the groups where the vaccine was administered via eye drop. In the NDV4-HR trial area, the chicken population increased by 140% and household consumption and sale of chickens also increased in the eye drop group. The I-2 vaccine trial ran for only 5 months but a 50% increase in chicken numbers was observed in eye drop groups by the end of the trial. In two districts benefiting from a VetAID project, the household chicken flock increased from 7 to 20 over a 6 month period where the vaccination of chickens with thermostable live ND vaccine was done by CLWs [14].

Both vaccines, when administered via eye drop every four months, yielded approximately 80% protection in the field. In the I-2 trial, no apparent difference was noted between groups that received the vaccine once only or on two separate occasions during the initial vaccination. In each trial, vaccination via eye drop provoked a greater HI titre than vaccination by other routes and more birds vaccinated via eye drop survived field outbreaks of ND. Although birds had to be caught to administer the vaccine by eye drop, this was the method preferred by farmers because of its efficacy.

3.3. Field trials with thermostable inactivated ND vaccine

The ITA-NEW vaccine field trial registered a 65% increase in the chicken population. During a buy back challenge, 95% of vaccinated chickens from the trial site survived the challenge with the local ND challenge strain under laboratory conditions [15].

3.4. Development of an appropriate extension package

A basic extension package was developed in conjunction with the two vaccine field trials using the thermostable, live ND vaccines, NDV4-HR and I-2 that were conducted over a two year-period.

Sixty one percent of the population is unable to read and write. However, when this figure was broken down according to gender, it was found that 74% of women were illiterate compared to 45% of men [1]. Priority was given to radio programs since radio is the means of communication that reaches the most people irrespective of literacy skills, even if access to funds to purchase batteries varies during the year. Programs could be easily translated by radio staff and transmitted in African languages by local stations. Video programs were excluded as they were considered costly and out of the reach of most of the farmers. All printed material was produced in black and white to enable duplication by photocopiers at the provincial level and to minimise ongoing costs at the completion of the project.

Communication with farmers was an integral part of field trials with thermostable ND vaccines and helped researchers to develop an understanding and appreciation of farmers' knowledge and priorities. In the preparation of extension material, special attention was paid to the perceptions and sensitivities of the village chicken owners. The insights gained from farmers enabled the development of material that addressed their concerns in a manner that also facilitated their comprehension. The different needs and capabilities of men and women were considered constantly during the fieldwork and elaboration of the written, visual and audio material. This approach resulted in the development of a comprehensive extension package that aimed to give farmers, extension workers and decision-makers the basic information needed to implement ND control activities successfully [16].

The current extension package includes a number of products and activities, such as:

ND vaccination song - recorded in Portuguese and three African languages by the Mozambican Musicians Association, the song was conceived after visiting one of the vaccine field trial sites. Its words are included in the ND field manual.

Radio programs - a radio drama and a question and answer program in Portuguese and four African languages are broadcast together with the ND vaccination song on national and community radios. The text of the programs is included in the ND field manual to facilitate the local recording of programs in other African languages.

Pamphlet - provides an introduction to ND and its control in Portuguese. It is printed on both sides of an A4 sheet and is easily reproduced. It is useful for front line extension staff, literate farmers, farmers' associations and school children.

Poster - consists of a large line drawing of a rooster, ND vaccine vials and an eyedropper. Written in Portuguese, the poster provides space for the local vaccinator to write the venue, date, time and contact person for the next ND vaccination campaign.

Calendar for the year 2000 - this A4 black and white calendar shows a woman vaccinating a chicken via eye drop. The months of March, July and November are highlighted to help people remember to revaccinate their chickens every four months.

Drama piece - was developed by a local theatre group with experience in community development after visiting one of the vaccine field trial sites. This piece runs for 20 minutes and covers most aspects of ND control including the need to vaccinate before chickens get sick and to pay for the vaccine. As the drama's text is included in the ND field manual it can be used, in the form of role-plays, during the training of extension workers and community vaccinators. Role plays developed and performed by participants are encouraged during training sessions.

ND field manual - a 73 page manual entitled 'Newcastle Disease in village chickens: a field manual', in A4 format, aims to provide information (in Portuguese) to senior veterinarians and veterinary field staff on ND and its control. Chapter headings include the importance of ND in village chickens, the characteristics of ND, the collection and submission of samples for the diagnosis of ND, the control of ND, an introduction to live, thermostable ND vaccines, gender aspects, ethnoveterinary knowledge and the development of an extension program for ND control.

Flip chart - a 28 page illustrated large-format booklet, A3 format with clear, largely self-explanatory line drawings and an accompanying narrative in Portuguese. It can be used for training and in the field, with farmers, to explain the characteristics of the vaccine and its application. Local frontline extension staff translate the Portuguese into the appropriate African language.

Video - detailing project activities was made by the Social Communication Institute for broadcast on Mozambican television. A shortened version of the video with English subtitles is available. Material in preparation includes a manual for trainers of community vaccinators and a simple checklist for community vaccinators.

3.5. Community livestock workers and community vaccinators

Community involvement increased in proportion to the amount of time given to extension activities prior to the commencement of the trials and the degree of community involvement in the selection of the local assistants. In each trial, community participation increased most in those groups where the vaccine was given by eye drop. In other groups, survival rate after natural challenge was lower, and in the case of the control group, many farmers lost interest altogether. No matter how much emphasis was given to the fact that a trial rather than a vaccination campaign was being conducted, many farmers simply wanted to see their birds survive.

The NDV4-HR trial proceeded with minimal difficulties. On the whole, the government extension worker and community assistants fulfilled their tasks admirably. The attempt to involve young women as community assistants in the I-2 field trial was not a success. They had little interest in serving the community, lacked responsibility and were unhappy with the amount paid for their services. In addition, they had a low profile within the community. This situation was compounded by the inadequate support provided to the women by the local extension worker.

While valid scientific results concerning the efficacy of the vaccines were obtained from both sites, the amount of useful information gained about farmers' perceptions was greater in the NDV4-HR trial site where interaction with the community had been greater.

3.6. Cost recovery and cost minimisation

In most areas where the I-2 vaccine is used, farmers paid a total of MZM 300 per bird (USD 1.00 = MZM 16,300). This charge of MZM 300 consisted of MZM 100 for the vaccine and MZM 200 for administration.

4. DISCUSSION

Many of the technical aspects associated with the control of ND in rural areas that lack cold chains have been resolved. The challenge of incorporating these technical activities into a sustainable program requires considerable attention to social, economic and management issues.

Special attention must be given to field activities to ensure that ND vaccination campaigns are successfully implemented. For instance, to ensure sustainability of the program, CLWs must:

- be assured of a reliable supply of vaccine (and other necessary inputs);
- receive appropriate training;
- be answerable to their community;
- be able to monitor their own work;
- be provided with incentive in cash or kind; and
- receive good technical follow-up and support.

The ND vaccination kit for CLWs should contain:

- syringe (10 mL or smaller if appropriate), needle optional;
- calibrated eye-dropper;
- ND Vaccine;
- damp cloth and basket (or a coolbox and ice pack were available);
- record book and pencil; and
- chicken marker—leg band, wing tag, coloured thread or cord.

Indicators of success to be used by CLWs to evaluate their work should be included in the training. This will also facilitate the supervision of the CLW by government veterinary and extension workers. Possible indicators may be:

- an increase in the number of chickens per family/household;
- farmers continue to participate in subsequent vaccination campaigns;
- new farmers appear with each campaign to have their chickens vaccinated; and
- payment received from farmers for the vaccination of their chickens is sufficient to buy vaccine for the following campaign and to cover any transport or labour costs involved.

The earnings from a vaccination campaign must be sufficient for the vaccinator to be able to buy a new batch of vaccine for the next campaign and to cover transport costs associated with the collection of the vaccine. Clearly, the profits are not great and this is one reason why it is essential that the vaccinator also be a village chicken farmer. The primary motivation for the vaccinator is the

protection of his/her own flock with the funds raised from the vaccination of neighbours' chickens being an additional bonus.

A robust vaccine distribution system is yet to be developed. Officially, all funds raised by government agencies must be returned to the central treasury. The establishment of revolving funds within government agencies such as INIVE is yet to be officially sanctioned. The production, distribution and use of the I-2 ND vaccine can only be sustainable if all involved in the process believe they are getting some benefit (be it financial or otherwise) from the exercise.

The price of the vaccine directly influences the number of doses that can be effectively used in the field. The I-2 ND vaccine is produced in eggs from minimal disease flocks rather than imported specific pathogen-free eggs in order to produce a vaccine of appropriate quality that is low cost. Flock testing is performed to ensure that the few avian diseases that may be vertically transmitted are absent from the MDF flock. Each batch of vaccine is subjected to quality assurance tests prior to sale.

The results of the ND vaccine field trials indicated that ND was a key constraint to village chicken production. Results obtained with the use of thermostable live ND vaccine in areas beyond the trial sites indicated that the return on investment for participating farmers was very high. The high annual chicken mortality due to ND in these areas would have made it virtually impossible to commence other poultry husbandry activities without first controlling ND.

In areas where the movement of poultry and people are infrequent, the prevalence of ND may be less. It is best to confirm that ND is a problem in new areas prior to embarking on ND control activities.

There are many activities that must be completed to ensure that ND control in village chickens may be sustainable in Mozambique. The registration process for the I-2 ND vaccine produced at INIVE for use in village chickens must be completed. Issues to do with cost recovery and utilization of funds generated by ND control activities need to be reviewed. The extension package should be reviewed at regular intervals.

Once ND control is a reality at the village level, attention must be given to addressing other constraints to village poultry identified by farmers, extension workers and researchers.

In conclusion, the foundation for sustainable ND control is almost in place after four years of research, debate and learning. With the completion of the extension package and the institutionalisation of an effective cost-recovery system, the ND control activities should be able to expand across the country over the coming years.

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