The Epidemiology of Newcastle Disease in Village Chickens

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Abstract

Newcastle disease virus (NDV) infects most avian species. The serious consequence is the disease (frequently fatal) that occurs when virulent strains of the virus infect domestic chickens. The epidemiology of Newcastle disease (ND) in commercial chickens is fairly well understood. Infected chickens are the usual source of virus, which can be transported mechanically by fomites or by people. Preventive measures include vaccination and attention to biosecurity. Village chickens are also susceptible to ND, which, in developing countries, is the most important constraint to rural poultry production. Similar epidemiological factors probably apply to the spread of NDV in commercial chickens and village chickens. Until recently, thermostable ND vaccines were not available for use in village chickens. Biosecurity is extremely difficult to practice at the village level. Both epizootic and enzootic ND are recognised in village chickens. Epizootics occur when virus is introduced to a susceptible population. Spectacular outbreaks with high mortalities result. Enzootic ND occurs when the virus transmits slowly in a partially immune population. In this case, there are too few susceptible birds to maintain an outbreak and the occasional birds that die do not come to veterinary attention. Possibly a breeding population of as few as 500 birds can sustain the virus, as indicated by computer modelling. Anecdotal evidence suggests that seasonal conditions favour the initiation of outbreaks. More likely, it is movement of poultry, especially through markets, that initiates and fuels an outbreak. Salvage sales increase the dissemination of virus once the disease is recognised. All village chickens are sold as live birds, for consumption or for breeding. It does not seem feasible to control this aspect of the epidemiology of the disease. Suitable vaccines seem to be the only answer to the control of ND in village chickens.

IN MANY countries, ND is an important infectious disease. Control is possible, but this requires efficient applications of vaccines, and rigorous biosecurity. The epidemiology of ND is fairly well understood in commercial chickens. Factors that influence spread between flocks can be addressed with physical and chemical barriers. Vaccination hinders spread within a flock. Aspects of the epidemiology of ND in commercial chickens have been reviewed by Alexander (1988) and Arzey (undated). Some of their observations are applicable to ND in village chickens.

Hosts

ND as a clinical entity is most important in domestic chickens. However, most avian species appear to be susceptible to infection, although few develop clinical signs. Turkeys and pigeons may also develop generalised disease, but clinical signs are rarely reported in geese and ducks.

ND has been isolated from a number of mammalian species. Replication of ND virus (NDV) in these hosts is probably not epidemiologically important for avian disease. Some strains will produce conjunctivitis in human patients (for example, laboratory workers and abattoir staff) and there are very occasional reports of an association with more serious human ailments.

Methods of Infection

Chickens are susceptible to infection by both inhalation and ingestion of NDV. It is generally supposed that chickens are more susceptible to virus reaching the respiratory tract, but this may not be the case for all strains of NDV. Strains vary in tropism for organs and some strains seem adapted to faecal-oral spread. Once ND enters a group of susceptible commercial

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chickens, the resulting explosive outbreak is easy to understand. Spread will probably be by aerosol within the crowded community, and airborne virus may travel long distances.

The difficulty is in explaining the first event in an outbreak—the infection of the first bird in an isolated flock. With most commercial flocks, the entrance of an infected chicken should not occur. Aerosol transmission is a possibility if there is a large concentration of infected chickens in the area. Estimates of airborne spread extend to 40 km. It is expected that, as with foot-and-mouth disease, a large group of animals that samples a large volume of air will be more susceptible to aerosol spread than a small group. Otherwise, the virus is probably carried in mechanically. Many factors may be involved—contaminated human shoes and clothing, vehicles, crates, egg cartons, eggs and contaminated food and food containers.

Village poultry are a different epidemiological problem. The flocks are small, scattered and multi-aged. During the day while chickens are scavenging, the entire village population could be regarded as a unit. All the chickens are in direct or indirect contact. At night, the chickens will congregate in smaller household groups, either in houses, under houses or in trees. Huchzermeyer (1993) made interesting observations on the role of housing in the epidemiology of ND in villages. He believed that chickens that were housed at night were more susceptible. Infection then occurred by close contact and sick birds would infect healthy birds. If the birds roosted in trees, there was less spread. Sick birds could not reach branches to perch and remained segregated. He also noted that brooding hens and hens with clutches of chicks that were kept segregated could also escape infection. His contention was that infection occurred more readily at night, in the absence of solar radiation.

Distant aerosol is probably a rare method of entry of virus into a village flock, although it could well be an important method of spread within the flock. Intense sources of aerosol/virus are not available in rural areas, and the small village flocks sample small volumes of air.

Movement of infected chickens is probably the main source of virus. Village chickens are mobile and pass through markets. They congregate, spread virus and disperse. Even chickens purchased for consumption are purchased live and may mix for a while with the home flock. Many villagers are aware that outbreaks of ND may follow the introduction of a newly purchased or newly gifted chicken.

Many villagers are also aware of the infectious nature of ND and of the failure of any treatments. Dead birds are often consumed. Sick birds or dangerous contacts are slaughtered for consumption, or sold. The sale of infected birds aids the spread of infection.

In many countries, outbreaks of ND occur at certain times of the year. There is a temptation to attribute the outbreaks to seasonal conditions. However, seasonal conditions may be only indirectly involved. Increased movement of chickens may be the direct influence. This has been suggested as the factor in Indonesia, where the planting of seedbeds requires the sale of household chickens to fund the purchase of seed rice. In Uganda, it has been suggested that outbreaks of ND during the dry season coincide with the travels of unemployed agricultural workers who carry chickens as gifts when they visit relatives. Outbreaks occur in other countries as flock numbers increase in anticipation of various festive markets.

Epizootic and Enzootic Newcastle Disease

Epizootic ND is the form that comes most readily to notice. Susceptible flocks in whole villages or whole areas become infected within a short time. Mortalities are high and sometimes total. Chickens that survive will be resistant during subsequent outbreaks. Most flocks will have to be started again with chickens from outside the area. This is the form that is reported to official agencies and that attracts the attention of aid groups. This is the form that discourages villagers from giving their flocks adequate attention. The flocks are seen as uncertain and ephemeral, suited only to opportunistic harvesting.

We now recognise that an endemic form of ND occurs, with the virus being maintained in a partially immune population. The virus spreads slowly among the susceptible portion of the flock, and the occasional deaths are not stressful to the flock owners, nor sufficiently serious to attract official attention. Clinically healthy chickens that are incubating the disease cannot be detected as potential killers of other flocks. The author has been involved in several experiments where chickens purchased as healthy controls have introduced virus to the laboratory. Others have had similar misfortunes with purchased village chickens.

Endemic ND and indeed the dynamics of village flocks are more conveniently studied by computer models than in the field. Johnston and Cumming (1991) described such a model, based on data collected in the Philippines. In their study area, flocks were exposed to ND challenge for about 14% of flock months. The model indicated that virulent virus could remain endemic in an environment that held as few as 500 breeding chickens with movement between groups. In a breeding flock, there is a constant introduction of susceptible newly hatched chicks.

Relevance to Control

In commercial poultry, an important aspect of the control of ND is the exclusion of the virus. This can include strict quarantine on a country basis and strict biosecurity on a farm basis. Biosecurity approaches will not protect village flocks from the predations of ND. There is no way to control the movements of people and of animals, nor of curtailing the marketing of live chickens. The most that can be expected is some element of biosecurity within the village. Extension messages should include the segregation of unhealthy birds and the proper disposal of dead birds, viscera and feathers that remain if the birds are eaten.

The other arm of ND control in commercial chickens is vaccination. This is often effective for the flocks are large and uniform, and vaccines can be kept at suitable low temperatures until the point of delivery. The vaccines are sophisticated and produced in large dose formats to achieve economies of scale. The use of these vaccines in village chickens is limited by cost, dose format and thermolability. Suitable vaccines are only now becoming available for village chickens. These will be relatively simple vaccines, locally made but derived from thermostable stock to reduce the reliance on refrigeration. New vaccination technologies and appropriate extension methods will have to be developed for each country.

References

Alexander, D.J. 1988. Newcastle disease: Methods of spread. In: Alexander, D.J. ed. Newcastle Disease. Boston, Kluwer Academic Publishers, 256–272.

Arzey, G. undated. Mechanisms of spread of Newcastle disease. Sydney, NSW Agriculture and Fisheries, Technical Bulletin, 42, 12 p.

Huchzermeyer, F.W. 1993. Why is velogenic Newcastle disease endemic in some countries and not in others? Zimbabwe Veterinary Journal, 24: 111–113.

Johnston, J. and Cumming, R. 1991. Control of Newcastle disease in village chickens with oral V4 vaccine. Canberra, Australian Centre for International Agricultural Research, Working paper No. 35, 63 p.