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Executive summary

Avian Flu Epidemic 2003:

Public health consequences

Investigation of risk factors, health, well-being, health-care needs, and preventive measures with regard to poultry farmers and persons involved in controlling the AI H7N7 epidemic in the Netherlands

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Abstract

Executive summary **Avian flu epidemic 2003**: public health consequences.
Risk factors, health, well-being, health care needs and preventive measures during the H7N7 avian flu outbreak control in the Netherlands.

It is estimated that at least one thousand persons were infected with avian flu during the outbreak in the Netherlands in 2003. One-third of the poultry farmers whose holdings were cleared reported stress reactions, fatigue, and depression.

The extensive spread of the virus to humans underscores the importance of measures to prevent poultry-to-human transmission among people handling infected poultry. The possible uncertainty, stress, and anxiety associated with avian flu control demand specific health care attention. A total of 453 people reported symptoms, predominantly conjunctivitis. Antibodies were found in 59% of family members of infected poultry workers. Of the 500 tested persons who had handled infected poultry, about 50% showed an antibody response.

The poultry farmers and workers did not comply adequately with preventive measures. The antiviral drug oseltamivir protected against infection, whereas a protective effect of mouth-nose masks could not be found.

The attention that was given to counseling of poultry farmers and other workers, and the attention given to the provision of information and communication during the clearing out of poultry worked well.

Approximately 25% of the poultry farmers worried about the survival of their holding and the sector as a whole, while 16% felt a need for additional support, help, or health care because of the avian flu. They usually consulted agricultural care providers and family doctors, less often mental health-care providers.

Preface

During the avian flu epidemic in 200l, an investigation was undertaken concerning the health risks for poultry farmers and for persons directly involved in controlling the epidemic. The investigation was carried out at the direction of the Ministry of Public Health, Welfare, and Sports. This report is the Executive Summary. The main report and associated supplements (reports 630940001/2004 and 630940002/2004) contain the full results of the investigation. The study participants receive a separate summary of the results.

First, we wish to express our gratitude to those who took part in the investigation; they have filled out a very extensive questionnaire, cooperated in interviews, and provided blood and/or saliva samples for this research.

In addition to the two research institutes, the National Institute for Public Health and the Environment (RIVM) and the Institute for Psychotrauma (IvP), many others have contributed to this research. From the Ministerie of Agriculture, Nature and Food Quality the Food and Consumer Product Safety Authority/National Inspection service for Livestock and Meat (VWA-RVV), the General Inspection Services (AID), LASER and the Legal department contributed to the realization of this research. The management and many employees of the Regional Crisis Center (RCC) in Stroe made it possible to set up a research unit there during the crisis. In addition, several Municipal Health Services (GGDs), regional laboratories, the National Coordinating Center for Infectious Diseases (LCI), the Virology Department of the Erasmus Medical Center, SEP, general medical practitioners and medical specialists, poultry service companies, employment agencies, communication and ICT experts gave their cooperation. Their contributions – giving advice, providing data files, commenting on research plans and methods, providing communication channels, commenting on draft reports, etc. – have made an important contribution to the end result of this investigation which is now before you. Many have made this contribution in addition to and beyond their already demanding tasks in the hectic time of the containment of the epidemic. The investigators are grateful for these valuable contributions.

The investigation was guided by a steering committee and a scientific advice commission. Both made an important contribution to the realization of the research and the report. The investigators are grateful for that contribution, which was often given under very pressing conditions.

A special word of thanks is also due to the many workers behind the scenes: the list of authors here, as in many publications, does only partial justice to the reality.
The effort and support of many others, from mail-room personnel, packers and unpackers, doormen, IT workers, press secretaries, administrative workers, secretaries, laboratory technicians, epidemiologists, and managers has been essential.

The investigation revealed several important new findings, which are described in the report. These findings can contribute to improving the containment of a future avian flu epidemic and limiting the health risks which may arise from it.

Contents

Summary

It is estimated that at least one thousand persons were infected with the avian flu virus during the epidemic in The Netherlands, 2003. Among those infected were people who came in direct contact with infected poultry as well as others living in the same households as infected poultry workers. The antiviral drug oseltamivir appeared to protect against infection, but a protective effect of mouth-nose masks could not be found. One-third of the poultry farmers on farms that were culled reported stress reactions, fatigue, and depression. The provision of information about treatment and the treatment itself during the culling were largely effective.

The extensive spread of the epidemic underlines the importance of measures to prevent transmission of the avian flu virus from poultry to humans by contact with infected poultry. The primary objective is to prevent the appearance of a new influenza virus that has greater ability to infect humans and to spread from person to person.

For many of those involved, combating the avian flue epidemic caused uncertainty, stress, and anxiety, for which specific care is needed. Correct and timely communication are crucial in this regard.

Shortly after the outbreak of the avian flue epidemic, a medical post was opened where people could report with symptoms which might be related to the epidemic. As a follow-up, a questionnaire survey was carried out. Approximately 400 poultry farmers and their families and almost 900 persons involved in controlling the epidemic participated in this investigation. Blood samples were taken from 500 participants to determine possible infection with the avian flu virus. In addition, 23 interviews were carried out and additional studies were performed in 62 household contacts of 25 persons with avian flu virus infection.

There were 453 persons who reported having symptoms, primarily conjunctivitis; in 89 of them the avian flu virus was demonstrated and 3 of these had had no contact with poultry, only with infected persons. Antibodies were also detected in 59% of the households contacts of infected poultry workers. Approximately 50% of the 500 persons examined who had contact with infected poultry during the epidemic had detectable antibodies against the virus.

Neither poultry farmers nor those combating the epidemic complied satisfactorily with preventive measures. The antiviral drug oseltamivir protected against avian flu infection and the associated symptoms. The investigation could not demonstrate a protective effect of safety goggles or mouth-nose masks.

Both the attention given to poultry farmers and others involved and the information about treatment and the treatment itself during the culling operations were adequate. Veterinarians recruited specifically for this outbreak found their tasks more often emotionally burdensome than did other professional groups involved in combating the epidemic.

About 25% of the poultry farmers whose farms were culled were worried about the survival of their holdings and of the sector as a whole, while 16% indicated that they needed additional support, help, or health-care as a result of the avian flu. They sought help from specific agricultural care-providers and the family doctor, less often from mental health-care providers.

The investigation provides recommendations for better protection and surveillance of public health in future animal disease epidemics. The main recommendations focus on improvement and integration of organizations and protocols for human and animal infectious disease prevention, and improvement in correct use of personal protective materials and antiviral drugs.

The model employed for guidance of affected poultry farmers, communication about treatment and actual treatment during culling operations is a starting point for future crises. Coordination of different care-providing agencies is needed.

1 Reason for the investigation

1.1 Introduction

In 2003 a large number of poultry farms in the Gelderse Vallei, Brabant, and Limburg were stricken by classical avian flu, also called Avian Influenza (AI). Because of possible health risks of AI for humans, an investigation was carried out among poultry farmers and their families and among professional groups involved in combating the epidemic (such as veterinarians, insurance appraisers, personnel of the National Inspection service for Livestock and Meat (RVV) and the General Inspection Services (AID), and those hired to carry out the clearing out).

This investigation, the Gezondheidsonderzoek Vogelpestepidemie (GOVE), was instigated by the Ministerie van VWS (Volksgezondheid, Welzijn en Sport), the Rijksinstituut voor Volksgezondheid en Milieu (RIVM) and the Instituut voor Psychotrauma (IvP).

This extensive summary is written in particular for those who commissioned the study, for the policy makers, and for those involved in preparing for control of crises and disasters (veterinary, public health). It deals with the planning, performance, results, and interpretation of the research. The emphasis is on the scientific results, as well as on the conclusions and recommendations. Those interested in reading all of the information are referred to relevant chapters in the main report (630940001/2004) and supplements (630940002/2004). For an overview of the recommended literature, see Chapter 8 of the main report.

1.2 Health risk: infection and consequences for humans

Avian flu is caused by type A avian influenza viruses. These viruses are divided, on the basis of characteristics of surface proteins, into H (Hemagglutinin) and N (Neuraminidase) subtypes. Thus far 16 hemagglutinin subtypes and 9 neuraminidase subtypes have been recognized. Waterfowl are considered to be the reservoir for these viruses but these birds are usually not ill. Disease occurs when these viruses are transmitted to poultry. The outbreak in the Netherlands in 2003 was caused by an avian influenza virus type A subtype H7N7 (A/H7N7).

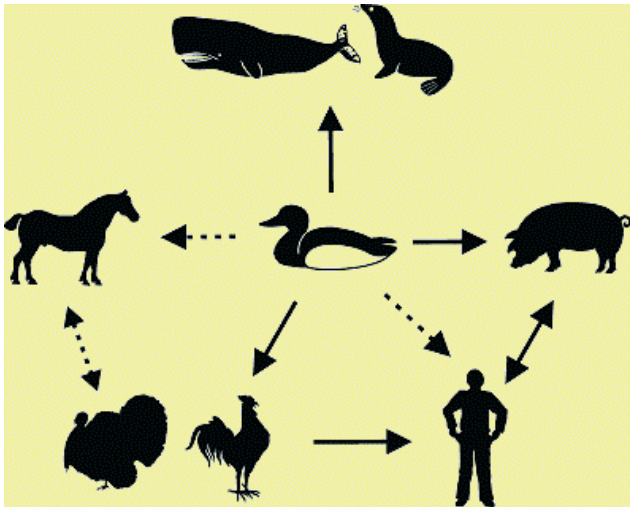


Figure.1. Possible routes of transmission of avian influenza virus between and among animal species and humans. Solid arrows indicate transmission routes that have been confirmed scientifically and dashed arrows indicate those that have not yet been confirmed.

AI can become a health risk for humans by adaptation of an AI virus to humans or by the combination of an avian and a human influenza virus to form a new virus (through a process called recombination). If a virus results that easily infects humans but against which there is no group immunity, the result can be a large-scale influenza epidemic (pandemic).

When avian flu was detected in Dutch poultry at the beginning of March 2003, the risk for humans had to be considered. Reports of human infections with AI were recognized previously in the literature, also with the subtype A/H7N7, and thus there was an indication of a risk. Based on the available information in the literature it was estimated that human exposure to A/H7N7 virus would lead to only sporadic infections (limited spread) and that infection would be associated with mild signs of illness (conjunctivitis). The situation was different with regard to the risk of mixing of the avian virus with a circulating human virus. This risk was also estimated to be small, yet real because the outbreak of the avian flu in poultry occurred at the same time as the yearly winter peak for flu in humans. The eventual consequences of mixing of avian virus and human virus could not be quantified, but they could well be far-reaching.

1.3 Health risk: stress-related complaints

Experience with recent national and international disasters has shown that these radical events can in themselves have effects on the health of those affected, not only physical but also mental and social. Hence in addition to symptoms arising from infection with the virus, problems of anxiety and stress-related complaints can develop due to, for example, the culling of a farm or even the threat of it, and the isolation resulting from restrictions on transport. Immaterial and psychosocial effects after an animal disease epidemic can be great and in some cases long-lasting. In material and financial terms, an outbreak can have great consequences. In addition, the agricultural community has already been dealing with economic problems for a long time. In the past 10 years various animal diseases have taken their toll (such as swine fever, foot-and-mouth disease, bovine spongiform encephalopathy). It is conceivable that such an accumulation of problems makes those involved more vulnerable in the event of a new crisis. From the beginning of the avian flu epidemic, various organizations have given attention to the psychosocial problems. Much attention has been given to the improvement of communication, the provision of information, and contacts with those involved in the culling, by such measures as the setting up of a Regional Information Center, the establishment of the LNV office, and the Agricultural Telephone Help Service. Further, much attention has been given to the improvement of the aftercare via the Social-Economic Plan (SEP, animal disease policy regarding support) and there have been regional and local initiatives undertaken by churches and municipalities. Within the VWA/RVV the trauma team was immediately put into operation (similar to the situation during the foot-and-mouth disease crisis). This trauma team has continually worked in close collaboration with the Institute for Psychotrauma (IvP) and had as its target group those involved in controlling the outbreak, except the AID.

2 What was investigated?

2.1 Objectives

The objective of the GOVE was to provide insight into the course of the AI infection in humans, the risk (direct or indirect) of transmission of the virus to humans, and the physical and psychosocial health, well-being, and health-care needs of those involved, by means of:

1 description of symptoms (conjunctivitis, influenza-like illness, other health problems) in persons exposed to A/H7N7-infected poultry
2 estimation of the risk of infection with the A/H7N7 virus in humans after exposure to infected poultry.
3 study of the effects of the type and duration of the exposure to A/H7N7-infected poultry on the infection risk for humans
4 description of the implementation and compliance with the control measures.
5 studying the well-being and health-care needs of those involved.
6 recording and evaluation of what was experienced during the avian flu epidemic
7 collection of relevant information in order to optimize health-care and aftercare.

To answer these questions, three studies were carried out:

2.2 Investigation 1: Surveillance of conjunctivitis and flu-like illness

The objective of this study was to describe the signs and symptoms consistent with flu or conjunctivitis in persons who had contact with infected poultry, investigation of the role of AI in the development of these symptoms, and investigation of the factors that contribute to infection of humans with AI after contact with infected poultry and with infected persons.

The investigation consisted of:

a intensifying the surveillance of Influenza-Like Illness (ILI), such as is routinely performed in the network of sentinel physician practices (NIVEL)
b active detection of new cases of disease (case finding) on the infected poultry farms A
c setting up of a case registry (of persons with health problems possibly related to AI)
d in addition to the active detection of new cases (b), an effort was made to quantify retrospectively the scope of the person-to-person transmission of the AI virus (contact investigation).

2.3 Investigation 2: Risk factors for transmission of AI virus

The objective of this investigation was the estimation of the risk of transmission of the AI virus from poultry to humans and from person-to-person. Virological and serological methods are necessary to detect AI infections in people. Virological methods were used to determine whether virus could be demonstrated in conjunctival or throat swabs from persons with symptoms. Serological studies were used to determine whether a person had produced antibodies, in this case against the A/H7N7 virus. This would also enable detection of asymptomatic infections, thereby providing a reliable means of determining the total extent of the dissemination of the avian flu virus in humans. Serological tests for the detection of antibodies to A/H7N7 in humans were not available and had to be developed.

2.4 Investigation 3: Psychosocial health, well-being, and health-care needs

This part of the investigation examined the extent to which the poultry farmers and their families, as well as persons involved with various aspects of the control of the avian flu epidemic, experienced stress-related symptoms (physical, mental, and social) as a result of the epidemic. For this purpose data were compared between farmers from infected farms that had been cleared by culling, farmers from non-infected farms that were culled preventively, farmers from which the animals were not removed. Data were also compared with data from the general labor force. In addition, the data from poultry farmers in the Gelderse Vallei (a district in the central part of the Netherlands)were compared with those from poultry farmers in Brabant and Limburg (districts in the south of the Netherlands).
The avian flu epidemic was demanding for all persons involved. It threatened their economic survival and ability to function, and it reduced their control over their own lives. From other research it is known that such loss of control is associated with various psychic and somatic stress reactions in the short and the long term. Stress is seen therein as a disturbed balance between the situation experienced by the individual and his or her ability to resolve the problems. The stress reactions can result in a variety of symptoms.
Affected persons also have a need for good communication about the implications of the crisis. They want to know exactly what has happened, what the underlying causes of the crisis are, how others are affected, and what damage has been done. If the provision of information is inadequate, then irritation, doubts, and distrust develop. These reactions can persist for a long time and disturb the functioning of individuals as well as the success of subsequent measures. Careful handling of affected persons as well as careful provision of information are therefore crucial (regardless of how difficult they may be to accomplish during the crisis).
In a high-impact situation people initially seek support from others in their immediate surroundings. For health problems many will seek help from care-providers in their own agricultural community. It is generally assumed that when faced with psychosocial problems, farming people – and thus also poultry farmers – are less likely to seek help from the 'regular' care providers such as public health and social workers.
Agricultural assistance and advice agencies and farm organizations are intended for more specific assistance for poultry farmers. It can be assumed that these agencies and organizations are more accessible to the poultry farmer than are the regular aid agencies.

2.5 How were the data collected?

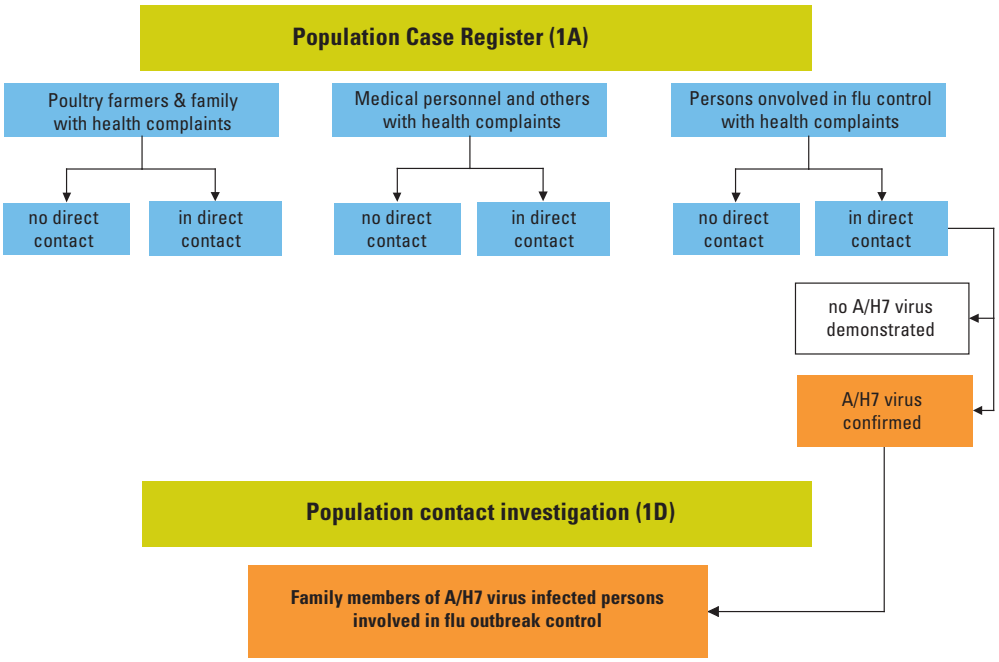
Data for the investigation were obtained via questionnaires and interviews, blood and saliva samples, information on the control of the outbreak (especially about the extent of contact with infected poultry, from the RVV), and information from the crisis center about affected poultry farms and indicators of exposure of other professional groups involved. In order to limit the demands on those involved as much as possible, investigations 2 and 3 were integrated and as much use as possible was made of information available from the Regional Crisis Center.
The questionnaire provided information on personal and demographic data; function, and work performed during the avian flu epidemic; possible exposure to AI-infected poultry or manure; informative arrangements and preparation for culling; experiences during culling; stress symp-

toms; fatigue and the quality of sleep; depressive feelings; the use of care; social contacts and the support they provided; general health and the occurrence of symptoms; the degree of use of protective materials; and experience with agricultural assistance and advice (the last only in Brabant and Limburg).
In addition, interviews were carried out to obtain qualitative information which is difficult to obtain by questionnaire. Other important sources of data for the investigation were: the Animal Disease Information System of the RVV, addresses of workers, and digital files such as the electronic archive system of the RVV.

2.6 Who participated in the investigation?

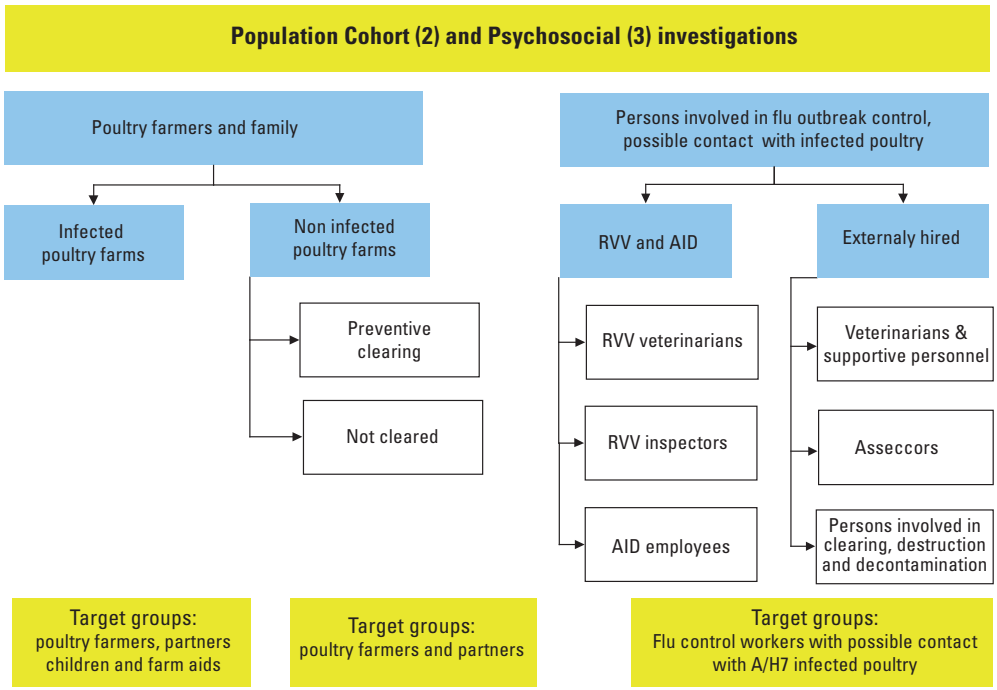
Shortly after the outbreak of the avian flu epidemic a registry was opened where people could report symptoms that might be related to the epidemic. Study 1 evaluated all persons in the regions affected by avian flu with complaints or symptoms consistent with flu or conjunctivitis and who could have had contact with infected poultry. In that category 453 persons with symptoms were investigated. The contact cohort study (1d) was carried out in 62 household contacts of poultry workers with confirmed A/H7N7-infection from the case-finding study (1a-c). *Figure 2* shows the composition of the different populations in study 1.

Figure 2. Research population in the surveillance and contact investigation (investigation 1)



Studies 2 and 3 were carried out in a broader population. It included persons who had intensive contact with infected poultry, persons who were involved in or affected by the culling out operations, and poultry farmers who were confronted with transport restrictions in the so-called 10 km zone (supervised area Gelderse Vallei — Beneden Leeuwen). Figure 3 gives an overview of the groups involved in investigations 2 and 3.

Figure 3. Research population cohort and psychosocial investigation (investigations 2 and 3).



Initially, studies 2 and 3 were carried out among poultry farmers within the restricted area Gelderse Vallei-Beneden Leeuwen. When the epidemic extended to Brabant and Limburg in October 2003, it was decided to extend the research to these areas. The most important reason was that Brabant and Limburg differed from the Gelderse Vallei in some aspects (farming methods, socio-economic structure, availability of support network), so that the findings in the Gelderse Vallei were not necessarily representative of the affected population in Brabant and Limburg.

For studies 2 and 3, a total of 1259 owners of poultry farms were invited to participate. These were all owners of poultry farms that were cleared because of AI and their partners. At least one person (owner and/or partner) of almost 33% of the farms agreed to participate in the study (in total approximately 400 persons). Persons keeping poultry as pets were not included in the study population.

Fifty percent of the 1747 invited persons who were involved in the control of the avian flu epidemic participated in this investigation. 500 persons donated blood and saliva samples to gain insight into the extend of transmission of AI to humans. In addition, 23 interviews were carried out.

Persons from all regions of the Netherlands were involved in the control of the avian flu epidemic. The majority of them came from the regions where the outbreak of the epidemic occurred. In addition, hundreds of foreign poultry workers were involved. Not all groups were evenly represented in the different studies; that applies especially to the cullers and foreign hired personnel (Eastern Europeans and Africans, among which were a group of asylum seekers). These groups are therefore underrepresented in the investigation.

3. Results

3.1 Results of investigation of infectious diseases (investigations 1 and 2)

The large number of AI infections in people and a possible explanation for this finding
In the week following the announcement of the outbreak of AI by the Ministy of Agriculture, Nature and Food Quality (LNV), veterinarians who were involved in the screening started to report eye complaints. When infection with the AI virus was demonstrated in one of them, it was decided to establish a case register in order that all health complaints could be reported and investigated in a standardized manner. With its 89 reported infections in people, this is the largest number of virologically confirmed AI infections in people ever described in the medical literature. We assume, however, that the number of infections in people as a result of the H5N1 epizootic in Asia was probably considerably greater.

Case finding (investigation 1)
Of the estimated 4500 persons who had contact with poultry in the infected areas, 453 reported symptoms. Of these, 349 had conjunctivitis, 90 had Influenza Like Illness (ILI), and 67 had complaints not fitting either of these two categories. Influenza virus type A/H7N7 was found in tearfluid of 78 (26.4%) persons with conjunctivitis only, in 5 (9.4%) persons with both ILI and conjunctivitis, in 2 (5.4%) persons with ILI only, and 4 (6%) persons with other symptoms.
Most of the positive samples were obtained within 5 days after onset of the illness. Among 83 householdcontacts of infected poultry workers, three people had a confirmed A/H7N7 infection, of whom one had also developed an influenza-like illness.
In 6 persons a common flu infection (human influenza A/H3N2) was confirmed. After the third week, when infection with A/H7N7 was confirmed in 19 persons, all poultry workers were vaccinated against flu and prophylactic treatment with the antiviral drug oseltamivir was offered to them. The majority of the A/H7N7 patients (56%) became ill before introduction of these measures.

The percentage of poultry farmers who developed eye complaints was about 5 times higher on infected farms than on noninfected farms (14% versus 2.4%). This suggested that the problems were caused by AI. Also among persons working to control the outbreak, there were relatively many eye complaints (average 12.2%). Finally, laboratory examination revealed that virus-positive conjunctival swabs were mainly found within 1 week after the appearance of eye complaints, which is more indicative of a real A/H7N7 infection than of eye irritation due to other causes (such as dust in the poultry buildings).

Influenza like illness was less frequent in persons who had contact with poultry in the infected areas. There were no significant differences between the control group and the group of persons who were exposed to AI. Apart from that, the onset of the epidemic occurred simultaneously with the regular seasonal peak for the flu virus. Because of this the flu symptoms due to the yearly surge in flu could have clouded the picture. On the basis of the above arguments, we conclude that the A/H7N7 virus caused primarily conjunctivitis.

However, one person (a veterinarian) developed a flu-like illness without conjunctivitis but with pneumonia and a fatal outcome. This clinical picture closely resembled what is described for the flu virus type A subtype H5N1, the AI variant that since the beginning of 2004 has caused widespread avian flu in Asia, via which people have also been infected and thus far 29 persons have died from the consequences of this infection. It is not known, however, which factors lead to this severe course of the disease.

From the combined results of serological studies and risk factor analysis we deduce that at least approximately 1000 persons who had contact with H7-infected poultry (persons involved in controlling the outbreak and poultry farmers) experienced an infection with the avian flu virus.

Risk factors for AI infection (investigation 2)

Conjunctivitis was more often observed in poultry farmers and others in the same household on infected farms (14%) than on noninfected farms (2.4%, RR=5.2; 95% CI 2.35–11.59). Antibodies against A/H7N7 were quite frequent in poultry farmers (63%) and in workers exposed to infected poultry (50.6%). The antiviral drug oseltamivir was observed to have a protective effect in persons involved in the epidemic. The results of the epidemiological study suggest that oseltamivir protects against conjunctivitis (OR=0.14; 95% CI=0.08–0.27) as well as against infection without specific symptoms (OR-0.47% ; 95% CI=0.25–0.88). No protective effect was demonstrable for safety goggles or mouth-nose masks. Contact with chicken manure was the only factor which, after correction for all other factors, was found to carry an elevated risk for conjunctivitis (OR=1.99; 95% CI =1.00– 3.93). Persons who screened poultry on infected farms had an increased probability of H7 antibodies (OR=2.12; 95% CI=1.10-4.07), after correction for other risk factors.

An important question is how the large number of infections by AI in humans can be explained. Possible explanations for this finding are:

1 properties of the virus that make it relatively easy to infect humans;
2 the intensive manner in which a search was made for indications of infection in humans during this investigation;
3 activities and properties of the exposed population.

Point 1. The first possible explanation is that the virus in this epidemic had properties such that it was relatively easy to infect humans, in contrast to other AI viruses. Flu viruses are known for their adaptability, which is related to the composition of their genetic material (RNA) and the manner in which it is copied in the generation of viral offspring. During this process errors often occur, so that from an infected cell many viral descendents are produced which differ slightly from each other.
The 'advantage' of this is that if conditions change (for example, if the virus ends up in another host), there is a chance that one of the offspring will have a better genetic composition for the new situation and will thus be selected. In the previous century, 3 new influenza viruses arose and led to the worldwide epidemics of 1918 (Spanish flu, estimated 40 million deaths worldwide), 1957 (Asian flu, around one million deaths), and 1968 (Hong Kong flu, about one million deaths).
The analysis of virus isolated from eye and throat swabs from people with conjunctivitis caused by AI revealed that there was scarcely an indication of alteration of the genetic material of the virus (mutations), compared with viruses isolated from poultry. Also during the epidemic no reassorted (mutated or newly formed) viruses were demonstrated. These findings gave no cause to assume that the large number of infections in humans can be explained by properties of the virus.
The virus isolated from the fatal infection of a veterinarian differed considerably, however, from that in the poultry, which suggests that the fatal course of the disease was the result of alteration of the virus. This is not certain, however, given that the virus from the poultry on the farm where this veterinarian became infected was not available. The great extent of the mutations in the virus from the fatal case is nevertheless of concern and justifies the active source and contact tracing and the treatment that was initiated in hospital personnel and in members of the family.

Point 2. The second and most likely explanation for the unusually large number of infections in persons is the active surveillance and tracing of cases of illness which was undertaken during this epidemic. Persons involved in the clearing out were actively approached and encouraged to allow themselves to be examined by GGD staff who were present in the crisis center. In this examination, in addition to the standard throat and nose swabs for flu examination, eye swabs were also made. Via this active case finding and the additional sampling of the eye, the likelihood to detect cases was greater than in routine flu surveillance, in which people are only examined when they themselves report with complaints and only a throat swab is obtained. Eye

Compliance with the protective measures

Among poultry farmers as well as workers in the outbreak, compliance with preventive measures was low. Among 124 poultry farmers on infected farms, 22 (17.7%) used mouth-nose masks and 4 (3%) used goggles while working. Only 8 (6%) of them used masks consistently, and one person (0.8%) always wore protective goggles. Of the 495 workers on infected farms in Gelderse Valley-Beneden Leeuwen, 366 (74%) used masks and 224 (45%) wore goggles while working. Consistent use by these workers was 25% (n=124) and 13% (n=62), respectively.

Of the 121 poultry farmers on infected farms, 46 (38%) reported that they received timely information about possible health risks and preventive measures. Oseltamivir prophylaxis was taken by 85 (48%) of the 185 poultry farms on infected farms and by 456 (75.5%) of the 604 persons brought in to help in the control on infected farms. Its use was interrupted unnecessarily by 324 (71%); according to those involved, this was mainly because of forgetfulness and reduced availability of the capsules.

The proportion of vaccination of poultry farmers was 48%, and 90% among persons involved in controlling the crisis. Of 428 persons brought in on infected farms, 109 (24%) thought that the preventive measures were not feasible. Problems in the use of personal protective equipment were regularly cited (61 workers), especially the misting up and poor fit of safety goggles (42 workers).

swabs provided a positive diagnosis significantly more often than did the standard throat and nose swabs. This could mean that infection of people by AI has also occurred more often in the past but went unrecognized. It must still be shown whether this is really the case. In the meantime, Canada has been confronted by an avian flu epidemic caused by a different subtype (A/H7N3), and by use of the Dutch protocols, eye infections were also confirmed. The absence of antibodies against AI (used in various investigations of the health risks in AI) is not a reliable indication of absence of infections, for it is now apparent that antibodies against AI virus in humans cannot be demonstrated reliably by the prevailing tests. More systematic investigation of persons involved in clearing out procedures should reveal to what extent our findings were unique for the Dutch epidemic or (more likely) apparently occur much more often. This applies also to contact with influenza virus with low pathogenicity for poultry (LPAI), although the apparent degree of average exposure is thought to be lower as a result of the smaller amount of virus shed in infections with LPAI. An important conclusion is that the behavior of flu viruses is rather unpredictable, so that adequate monitoring is of great importance.

Point 3. The third and last of the possible explanations for the large number of infections in persons are the activities and characteristics of the exposed population. In all analyses of the questionnaires, the extent of contact with manure from infected poultry emerged as the exceptional risk factor for conjunctivitis. This is based on the question whether the work clothing became soiled. Poultry farmers who were involved in the screening of poultry, and thereby in direct contact with chicken manure, had a markedly higher risk of eye complaints. In other persons involved in the control of the epidemic, direct contact with manure from infected chickens was the only risk factor that consistently emerged from all of the analyses.

Risk of person-to-person transmission of the AI virus

The findings of this study concerning the transmission of AI virus from poultry to humans are comparable to those of epidemiological studies of risk factors for transmission of the A/H5N1 virus in Hong Kong in 1997. Those studies found that exposure to live poultry in the week before the onset of symptoms was associated with a significantly greater risk of illness, in contrast to the preparation or consumption of poultry. On the basis of these studies and investigation of the occurrence of AI in poultry in the markets, the so-called 'wet markets' (dealing with living animals) were identified as a risk factor.

With the hemagglutination inhibition (HI) method used by the RIVM for measuring circulating antibody levels, reactivity was measured in the sera of a large proportion of the persons in whom culture or PCR had confirmed eye infection by A/H7N7 virus. The results were compared with those in a control group of healthy persons who had been vaccinated recently with the

same flu vaccine administered to persons involved in the avian flu epidemic. Although the observed antibody levels were significantly lower than those occurring after infections with human flu viruses of group A, the difference in reactivity (none of control persons versus 85% of those with confirmed A/H7N7 infection) indicated that we consider the specificity of the serological test to be high. This was confirmed by our finding that the preventive use of oseltamivir by persons who worked on infected farms reduced the occurrence of antibodies. We also demonstrated that there was a significant relation between measurable antibodies and the presence of eye symptoms. The prophylactic use of oseltamivir had an effect on that relation. These results supported the idea that the observed antibodies were the result of an A/H7N7 avian flu infection. For confirmation, the sera will be examined at the National Influenza Center in Collingdale, England, with tests that were used to analyze sera from persons exposed to the A/H7N1 virus during an AI outbreak in Italy in 1999. These tests may have to be adapted for the Dutch H7N7 virus, which will cause a slight delay before the results are available for interpretation. However, our analyses show that a much larger percentage than expected (58.9%) of the family contacts of persons having direct exposure to poultry had a measurable response in the HI test. This means that the person-to-person transmission of the virus occurs much more often than has been assumed.

Contact investigation (1d)

Of the 62 persons from 25 households of A/H7N7-infected workers, 8 reported health complaints. Four had conjunctivitis, of whom 2 also had ILI and 2 had only ILI. H7 antibodies were observed in 33 persons (58.9%). Conjunctivitis occurred more often in household members with allergy in their medical histories (RR=10.3, 95% CI 1.2-91.0).
A/H7N7 infections occurred more often in households with pet birds, in households with two or more toilets, and in persons using cloth handkerchiefs. The use of paper handkerchiefs appeared to protect against H7 infection (RR=0.6 95% CI 0.4-0.99).

These findings underline the importance of measures to prevent transmission of the virus from poultry to humans during handling of infected poultry. Each transmission to a human and each secondary transmission creates an opportunity for selection of a variant with a greater capability to infect humans and to spread among humans.

Use and effectiveness of protective measures

Outbreaks of avian flu are observed more often. The recent Asian outbreak of a highly pathogenic variant (A/H5N1) in poultry is so extensive that it has become inconceivable to provide all potentially exposed persons with preventive measures such as of masks, safety goggles, and/or antiviral drugs. Hence there is an increasing need for information about specific risk activities and the effectiveness of protective measures in order to make optimal use of sometimes limited resources. With regard to the use and effectiveness of protective measures, the investigation produced some relevant findings. First, both poultry farmers and workers that has used the antiviral drug oseltamivir consistently had significantly fewer eye complaints and significantly lower levels of antibodies against A/H7N7. This is an important finding because the effectiveness of oseltamivir for treatment and prevention of AI had previously been demonstrated only in animal experiments. Before application during the epidemic in the Netherlands, the sensitivity of the A/H7N7 virus for oseltamivir was evaluated in tissue culture. The importance of this verification of drug effectiveness was underlined during the Asian fowl plague epidemic at the beginning of 2004, where it

On 14 April 2003 the Outbreak Management Team (OMT) reported poor compliance with the advice on the use of personal protective equipment. In light of the results of the investigation, the recommended measures were certainly not superfluous. Unfortunately, however, it appeared that they were scarcely followed in practice and their effectiveness could not be demonstrated. That is remarkable, since it can be assumed that proper use of safety goggles and masks should reduce the number of infections with AI. The lack of really effective protective measures probably contributed to the great extent of the spreading of the avian flu virus in humans.

appeared that the circulating virus was not sensitive to one of the antiviral drugs. This was, however, a drug from a category other than neuraminidase inhibitor, to which oseltamivir belongs.

In light of the results of this study, the measures recommended in the Netherlands were thus certainly not unnecessary or excessive. However, on 14 April 2003, the Outbreak Management Team (OMT) reported that compliance with them was poor. This study revealed emphatically how poor the compliance was. In the initial phase of the epidemic the necessity for use of personal protective measures was regularly discussed. The importance of hand washing was also emphasized, for persons with or without symptoms, and also at home. The OMT advised at that time that a hygienist should be stationed in the crisis center.
Almost none of the poultry farmers made consistent use of safety goggles and masks and the workers also failed to use them consistently. Various reasons were given, such as 'I was not informed' or 'they didn't fit' or 'they were difficult to obtain' or 'the advice was nonsense'. What might have also played a role is that the message about health risks was changed, which can lead to confusion and undermining of the advice that was given out, even though sometimes this situation can't be avoided with a new infection risk. The provision of antiviral medication was also not without problems, for at least according to some respondents, the capsules were not always available on time.

This study could not demonstrate a protective effect of masks and safety goggles. That is remarkable, for the presumption is that with good use the chance of infection must be decreased. The question is thus whether the correct materials were used, and whether the instructions were correct. Conjunctival infection might also occur while a soiled overall is being taken off, even though safety goggles had been worn consistently during the work.

3.2 Results concerning psychosocial health, communication, treatment, and health-care needs

Psychosocial health

Studies were undertaken to determine the effects of the avian flu epidemic on the psychosocial health of: 1) poultry farmers of cleared-out farms (both infected and preventively cleared out) and not cleared-out farms (poultry farms in the supervised area), and 2) workers in the different professional groups involved in control procedures.

a. Poultry farmers

Among poultry farmers on cleared-out farms, there were more reports of stress reactions (33%), symptoms of fatigue (29%), and depression (32%) than among other groups employed from the Dutch labor force (16%, 16%, and 20%, respectively). The groups of poultry farmers from cleared-out and not-cleared-out farms did not differ between themselves on the health aspects studied, but as a whole they reported more health problems than other groups of workers. Almost 15% of the poultry farmers considered their own health to be much worse after the epidemic than before. These findings give a global indication that the higher percentages of persons with complaints was related to the avian flu epidemic. The lack of reference values for these agricultural professions prevents a better comparison with the occurrence of these health problems before the epidemic.
The 30 poultry farmers in Brabant and Limburg who indicated that they were concerned about

the future of their farms reported more symptoms of depression, stress, fatigue, and difficulty in sleeping than poultry farmers who were not worried about their future. This investigation revealed that 'being concerned about' was a more important indication of psychosocial problems than 'being cleared-out or not-cleared-out'.
Ten percent of all poultry farmers expressed concern about infection with the avian flu virus. In this regard there was no difference between poultry farmers on infected and preventively cleared-out farms versus not-cleared-out farms. The most frequently mentioned points with which poultry farmers were concerned in connection with the avian flu were uncertainty about when poultry production could be started up again and the uncertainty about the future of the farm and the entire sector.

b. Professional groups involved in the clearing out
There were more reports of fatigue in the professional groups involved in combating the avian flu epidemic than in the general population, but stress and sleep problems did not occur significantly more often.
Veterinarians hired to help in the epidemic found the work more taxing emotionally than did other professional groups involved in the work. They also reported more stress reactions.
What mostly occupied professional groups involved in the epidemic control was the concern for the future of the sector. Less than 10% indicated concern that they themselves might become infected with the avian flu virus.
There was no indication that previous involvement in combating animal disease resulted in either fewer or more stress-related health.

Communication and treatment
Earlier investigation of cattle farmers struck by the foot-and-mouth disease (FMD) crisis revealed dissatisfaction with the treatment offered during the clearing out. In the avian flu epidemic several agencies therefore explicitly gave great attention to this subject. The improvement in communication and provision of information in comparison with the FMD crisis, and the improvement of contacts with those involved in the clearing out operations, were accomplished in part by setting up a Regional Information Center (RIC), the LNV Information Service, and the Agricultural Helpline. Much attention was also given to improvement of the aftercare via the Social Economic Plan (SEP, animal disease policy with support) and both regional and local initiatives were undertaken by the church (Social Emotional Support for Farmers SEBA/ pastoral work) and municipal administrations.

a. Poultry farmers
In spite of the hectic situations during the avian flue epidemic, the majority (90%) of poultry farmers were satisfied with the way in which they were treated during the clearing out.
The majority of all poultry farmers thought that they were quickly informed of the necessity for clearing out and that the procedure was quickly started (average 75% in both cases). According to 45% of those who were asked, the information about how the clearing out would be carried out did not agree or only partly agreed with what actually took place. This was associated with more depression and stress reactions (43% and 46%, respectively) than in those who did not express this opinion (22% and 24%). The poultry farmers in the Gelderse Valley and in Brabant and Limburg did not differ among themselves on these points.

Poultry farmers were informed about various aspects (clearing out, protective measures, etc.) from various sources. Among those whose farm was cleared out, 81% indicated that they had received enough information about where to obtain answers to questions about avian flu.

After the clearing out, the poultry farmers especially needed practical information about such matters as when they could resume operations, how much of the loss would be compensated, and what must be done with the chicken manure.

b. Professional groups involved in the clearing out
Among the professional groups involved in the clearing out operations (excluding the members of AID and the insurance appraisers), 71% said that they had been informed about how the work would be carried out. However, those actually doing the clearing out, in contrast to other groups involved, more often reported that they were not informed.
About half of those involved in the clearing out said that they were not prepared to handle the strong emotions of those affected. Those actually doing the clearing out and the temporary helpers from outside reported this most often (74% and 77%, respectively).
Outside veterinarians hired in to help reported that they found the work to be emotionally taxing, more often than did other professional groups involved.
The professional groups involved in the epidemic were generally treated with respect and listened to with attention, but some of the poultry farmers responded with verbal aggression: about 35% of the professionals involved in combating the epidemic reported that they had experienced this at least once (in a few cases, multiple times), while 20% of those doing the clearing out had the same experience.

Health-care needs and evaluation of assistance
An analysis was made of the extent to which different groups of poultry farmers (infected or preventively cleared-out, not-cleared-out) and their partners made use of the regular and the agricultural help services.

The family doctor is the first one to whom poultry farmers turn for many health problems. Among poultry farmers of cleared-out farms, 19% contacted the family doctor and 5% contacted the social worker. In the Gelderse Valley, 52 poultry farmers had many depressive symptoms and 62 had stress reactions. In Brabant and Limburg, 33 had depression and 38 had stress reactions. These poultry farmers more often contacted the family doctor (in both the Gelderse Valley and in Limburg, around 30%) and the social worker (only in Brabant and Limburg, around 15%).
A considerable proportion of the poultry farmers and their partners in Brabant and Limburg (40% and 65%, respectively) said that in case of severe psychological problems, they would seek the help of the Mental Health Services (GGZ) or the social worker. Among poultry farmers of cleared-out farms in the Gelderse Valley and in Brabant and Limburg, 5% sought the social worker and 4% the GGZ.

Of the poultry farmers in Brabant and Limburg with many health complaints such as stress reactions, depression, sleep problems, or fatigue, 40-60% contacted agencies familiar to them, such as the LNV-Information Service, the LTO Agricultural Helpline, SEP information, and the regional offices of LTO/NOP (all around 40%) and SEP (about 60%). Among poultry farmers on cleared-out farms, 16% indicated a need for supplementary support, help, or health-care as a result of the epidemic. Their greatest need was for financial support; they had less need of support for health and family affairs. Poultry farmers on farms that had been cleared out in the Gelderse Valley and in Brabant and Limburg did not differ in this regard.

To support the poultry farmers there was, in addition to the RCC and the telephone help service for farmers, the SEP. About half of the poultry farmers in Brabant and Limburg made use of the SEP (SEP information and/or SEP cattle breeding). When poultry farmers spoke with someone

from the regular or agricultural advice and help services, in most cases they found that they were helped by the call. Among poultry farmers on cleared-out farms, 16% reported that they needed supplementary support, help, or health-care as a result of the epidemic. Poultry farmers on cleared-out farms in the Gelderse Valley and in Brabant and Limburg did not differ in this respect. The main need of these poultry farmers was for financial support.

4. Conclusions

4.1 Introduction

The conclusions are presented in the same order as the objectives, which were:

1. description of the symptoms (conjunctivitis, influenza-like illness, other health problems) in persons exposed to A/H7N7-infected poultry
2. estimation of the risk of infection with the A/H7N7 virus in humans after exposure to infected poultry
3. study of the influence of the type and duration of the exposure to A/H7N7-infected poultry on the infection risk for humans
4. description of the implementation and compliance with the measures
5. inventorying the well-being and health-care needs of those involved
6. recording and evaluation of what was experienced during the avian flu epidemic
7. collection of relevant information in order to optimize health-care and aftercare.

4.2 Conclusions: Infectious Disease Investigation

Conclusions for Objectives 1-3: Infection risks

1. The variant of avian flu that erupted in 2003 in the Netherlands (Avian influenza A virus subtype H7N7 (AI A/H7N7)) can cause infections in humans after unprotected contact with infected poultry or their feces. Symptoms observed among persons with a confirmed AI A/H7N7 infection are conjunctivitis, sometimes together with flu symptoms. A relation between AI H7N7 infection and flu symptoms could not be demonstrated.
2. The majority of the AI A/H7N7 infections in the examined groups were asymptomatic. From the combined results of the serological studies and risk factor analyses, we deduce that at least 1000 persons who had contact with H7-infected poultry (persons involved in the control and poultry farmers) developed an infection with the avian flu virus.
3. In one exceptional case the infection had an abnormal course with a fatal result. It is not known which factors result in a severe course.
4. A/H7N7 appears to be transmissible from person to person in a household situation.
5. In households in which pet birds were kept, there was an increased probability of transmission of avian flu from an infected person to others in the household. It is not clear how pet birds play a role in the transmission of the virus to humans. The use of paper handkerchiefs reduces the chance of transmission of avian flue from person to person.
6. That AI can be transmitted to humans by contact with infected poultry was to be expected, but the nature and extent of the infections and the transmission from person to person that occurred during the avian flu epidemic in 2003 were not anticipated.
7. Persons who have had direct contact with infected poultry can spread the virus, not only by carrying the virus on soiled clothing and hands but also by becoming infected themselves.
8. Persons with a symptomatic AI infection shed virus for more than 3 days. Hence they may be infective for poultry longer than the 3 days now specified as the waiting period during which contact with poultry is forbidden after contact with poultry or manure at a site on which there are infected poultry.

9. During the epidemic in the Netherlands, the A/H7N7 virus underwent a remarkable number of mutations in one person (evidence found in the genetic material of the virus). This provides confirmation that the mechanism by which influenza viruses can change (for example, into a pandemic virus) can already occur in a primary infection. However, there are no indications that the mutated virus in this case posed an increased risk to the environment of the patient.
10. The methods routinely used for demonstration of human flu virus and antibodies are not suitable for demonstrating infection with AI
11. With a new HAI test, antibodies were found in 85% of the patients with conjunctivitis caused by AI and in none of the examined control persons. A statistically significant relation was demonstrated between conjunctivitis and detection of antibodies against H7 in humans. Also, the antiviral drug oseltamivir had an effect on the demonstration of these antibodies. These findings make it highly probable that this test reliably measures H7 antibodies in humans, which makes it a usable test for detection of recent A/H7N7 virus infections.
12. Antibodies against H7 were also found in a high percentage (58.9%) of family contacts of patients with a confirmed A/H7N7 infection, which indicates a virus infection. The high degree of spreading among family contacts was completely unexpected for this type of avian flu virus.
13. The prophylactic use of the antiviral drug oseltamivir protects against AI infection and has been included in the manual for avian influenza produced in the winding up of the investigation. It is essential to continue monitoring the sensitivity of detected viruses for this drug, since development of resistance of the type A flu virus to neuraminidase suppressors has been reported.
14. In this epidemiological study, safety goggles and mouth-nose masks were found to have no protective effect. The manual that was in use gave no instruction about the sequence to follow in removing protective clothing, and hence the goggles and mask might well have been removed before the dusty overall, allowing mucosal surfaces to be exposed.
15. The chance of acquiring AI is increased in proportion to exposure to manure from infected poultry.
16. Infection with AI was confirmed in a few persons carrying out the clearing out (from Poland and Belgium) who were beyond the jurisdiction of the Dutch authorities after they returned to their home countries. They constituted a small but uncontrolled risk of spreading of AI to those countries. In addition, it is probable that eventual complications of AI in those persons would not be recognized as such by local physicians.
17. The employment of persons lacking knowledge of the Dutch language increased the risk of infections because instructions (without adequate translation) were less well understood.
18. Participants in this investigation indicated that advice intended to prevent infection with AI was inadequately followed in practice.
19. The effects of infections of persons with the AI virus on the clinical course and the chance of adaptation of the virus by alteration of genetic material (mutation) or mixing of genetic material of the avian and human viruses (recombination) cannot be predicted on the basis of present knowledge.

Conclusions for Objective 4:
Implementation of and compliance with protective measures

20. Antiviral drugs were used for prophylaxis by 48% of the poultry farmers and 76% of those combating the epidemic. More than two-thirds of the persons examined who were taking antiviral prophylaxis had interrupted treatment at least once. The reason given by almost half of those who interrupted treatment was that they had received too few capsules or that it was difficult to obtain the drug.
21. Poultry farmers and workers on infected farms scarcely made consistent use of masks and safety goggles, which according to the hygiene instructions from the LNV, were required. One-fourth of the respondents among those combating the epidemic found the measures unachievable, about half of these giving as the reason that there were practical problems in their use, such as misting up or poor fitting of the goggles.

4.3 Conclusions: psychosocial health, communication, treatment, and health-care needs

Conclusions for Objective 5:
Inventorying the well-being and health-care needs of those involved

Psychosocial health

1. About one-third of the poultry farmers on farms that were cleared out contended with stress reactions (such as tension, gloominess, nervousness) and fatigue caused by tension and depression. The investigation revealed that poultry farmers in the supervised area, where there was no clearing out, had to deal with these health complaints to the same extent as poultry farmers whose farms were cleared out. These health problems were roughly one-and-a-half times more frequent among the poultry farmers than in the general population of the Netherlands.
2. The conclusions are comparable with regard to social contacts. Limitations in social contacts because of the avian flu epidemic affected poultry farmers on cleared-out and not-cleared-out farms to the same degree
3. Poultry farmers at a location with infected poultry in the Gelderse Valley reported more stress reactions than did those on preventively cleared farms and on cleared-out poultry farms in Brabant and (and to a great extent also poultry farmers on preventively cleared farms).
4. There appeared to be a significant relation between concern for the farm and health complaints. Brabant and Limburg poultry farmers who were concerned about their farms farm suffered more often from depression (86%), stress reactions (65%), fatigue, and sleep problems (75%) than did poultry farmers who were not concerned (16%, 17%, 16%, and 11%, respectively).
5. Of the poultry farmers and professional workers involved in the clearing out, 10% reported that they were concerned about infection with the avian flu virus. There were no differences in this regard among poultry farmers on infected farms, preventively cleared-out farms, and farms not cleared.

6. Among professional groups involved in the epidemic, just as among poultry farmers, fatigue was reported abut twice as often as in other professional groups in the Dutch population. The need for rest among persons involved with this epidemic was thus greater than normal. Professional groups involved in the epidemic reported no more sleep problems or stress reactions (tension, pessimism, gloominess, feeling nervous) than other professional groups in the Dutch population.
7. In comparison with other groups involved in the epidemic, veterinarians brought in from outside more often found the work to be emotionally taxing, reported more stress reactions, and found that they were not prepared for the emotional reactions of the poultry farmers.
8. There was no evidence that previous involvement in controlling animal diseases was associated with either more or fewer health complaints. Previous involvement in controlling an animal disease epidemic thus did not of itself constitute a health risk.

Material and financial assistance and support for poultry farmers

9. Of the 94 poultry farmers on cleared-out farms in Brabant and Limburg, 24% indicated that they had great to very great concern about the survival of their farms. This concern could also be sensed in the other professional groups. Hence worry about the future of the sector was most frequently mentioned as the subject with which they were most occupied.
10. In comparison with poultry farmers in areas with infected poultry, those whose farms were cleared out preventively more often indicated that they could not bear the financial consequences of the epidemic with the financial support that was being promised.

Conclusions for Objective 6: Recording and evaluating the experiences of those involved in the avian flu epidemic

Information about and preparing for the clearing out

11. Most of the poultry farmers thought that they were quickly informed of the necessity of the clearing out and that the work was quickly begun (both averaged 75%). They were also generally satisfied with the handling of their questions by the RIC (63%). It can be concluded that the provision of information was generally satisfactory. Some improvement can be made especially in the provision of information about the clearing out.
12. According to 45% of the poultry farmers questioned, the information about the clearing out was partly or entirely not in agreement with what actually took place. They were thus led to have other expectations or the information they received was subject to more than one interpretation. These farmers reported significantly more health complaints such as depression, fatigue, stress reactions, and problems in sleeping.
13. Among professional groups involved in the clearing out (with the exception of members of the AID and insurance appraisers), 71% reported that they had been informed about the way in which the clearing out would be conducted, although only 52% of those actually performing the clearing out felt they were informed.
14. About half of all persons combating the epidemic found that they were not prepared for the strong emotions exhibited by those affected by the epidemic. The proportion was higher among those actually doing the clearing out (74%) and helpers brought in from outside (77%).

Treatment and reactions of those involved during the clearing out

15. In spite of the hectic situations during the epidemic, 90% of the poultry farmers were satisfied with the manner in which they were treated during the clearing out. From this it can be concluded that most of the professional groups involved generally handled the work adequately.
16. Professional groups involved in the epidemic found that in general they were treated with respect and given serious attention, but about 35% of them had to deal with verbal aggression from poultry farmers at least once (and in a few cases multiple times). This was also experienced by 20% of those actually doing the clearing out.

General information

17. Poultry farmers received information from various sources about various aspects of the epidemic (clearing out, protective measures, financial measures, etc.). Most (81%) of those whose farm was cleared out said that they were adequately informed about where to obtain answers to questions about avian flu. From this and other findings it can be concluded that the provision of information generally proceeded satisfactorily, although there is room for improvement.
18. After the clearing out, the poultry farmers mainly needed practical information about such things as when they could resume operating their farms, the extent of compensation they could receive for the damage, and what must be done with the poultry manure.

Conclusions for Objective 7: Collection of information relevant to optimizing the care and aftercare of those involved in the epidemic

19. A large proportion of those poultry farmers who had many health complaints (depression, fatigue, problems with sleeping, and stress reactions) contacted agencies with which they were familiar in the agricultural world, such as the LNV Information Service, LTO Agricultural Helpline, SEP, regional offices of LTO/NOP (all of these around 40%), the branch associations (about 45%), and SEP cattle breeding (about 60%).
20. The poultry farmers could obtain support not only from the RCC and the telephone help service but also from SEP. About half of them in Brabant and Limburg made use of SEP information and/or SEP cattle breeding and among those with many problems or concerns the proportion was 75%.
21. When poultry farmers spoke with someone in the regular or agricultural assistance services, they received help and support from the conversation.
22. Following the avian flu epidemic, 5% of the poultry farmers on cleared-out farms sought help from social workers and 4% turned to the Mental Health Services.
23. Poultry farmers and their partners who had many health complaints (depression and stress reactions, measured by validated questionnaires) more often contacted the family doctor (about 30% in the Gelderse Valley as well as in Brabant and Limburg) and the social worker (about 15%, only in Brabant and Limburg) than did poultry farmers and their partners who had relatively few of these complaints. Poultry farmers with many of these types of complaints turned especially to physical (medical) health-care sources and less to mental health-care.
24. In contrast, a much larger proportion of the poultry farmers and their partners in Brabant and Limburg (40% and 65%, respectively) indicated that in the event of serious psychological problems in the future, they will seek help from the GGZ or the social worker.

25. Among all poultry farmers on cleared-out farms, 16% indicated the need for supplementary support, help, or health-care as a result of the avian flu epidemic. Those on cleared-out farms in the Gelderse Valley and in Brabant and Limburg did not differ in this regard. They needed mainly financial support and less support for health and affairs concerned with the family.
26. In comparison with poultry farmers in areas of infected poultry, those whose farms were cleared out preventively more often indicated their inability to bear the financial consequences of the epidemic with the financial support being promised.

5. Recommendations

The recommendations are presented in the same order as the objectives.

5.1 Recommendations for investigation of infectious diseases

Recommendations for Objectives 1-3: Infection risks

1. Infection with AI is a professional risk for persons working in the poultry sector. The available hygiene protocols for protection of these persons in the manual for animal disease prevention of the LNV should be reviewed in light of the experience of the AI crisis and sharpened where necessary. In view of the increasing evidence for risks of human infection by AI, consideration must be given to all types of AI, including viruses with low pathogenicity for poultry.
2. Implementing personal protection against risks arising in zoonoses is largely under the direction of the LNV, while advice about new risks for public health is arranged via the LCI/OMT/BAO structure under the responsibility of the VWS. During the AI crisis, advice from the VWS as well as the LNV manual and the VWS manuals had to be translated and implemented. This complex structure impeded direct communication about new risks. It is necessary to arrange a better division of tasks for all parties and better direction over performance aspects at all levels of combating the epidemic. Since it concerns public health risks, it is obvious that the VWS should take the initiative.
3. Knowledge about zoonoses must receive greater attention by medical personnel and services who deal with them (GGD/general practitioners/ophthalmologists/occupational health physicians LNV/RVV), so that the contribution and responsibility of the VWS becomes more obvious. It is clear that the VWS should take the initiative.
4. The waiting time of 3 days in the current LNV protocols to prevent carrying virus to other farms must be increased.
5. The current protocols for prevention of AI in humans should be reviewed and modified as needed, now that it is known that transmission of the virus from poultry to humans and from person to person occurs more often than was realized when these protocols were created. A specific question here is whether criteria should be set for the use of antiviral drugs by family contacts.
6. During future AI epidemics, pet birds in households of AI-infected persons should be examined for signs of AI infection.
7. The manual for avian flu epidemics should include measures to prevent as much as possible the spreading of virus outside the infected area by personnel brought in to help in combating the epidemic

Recommendations for Objective 4: Implementation of and compliance with protective measure

8. On the basis of the evaluation of the use of protective measures during the AI epidemic, the instructions available in an AI crisis must be sharpened. This includes investigation and testing to determine which types of face and eye protection are suitable for working in various situations.

9. Instructions for use of protective clothing should include their proper use, the order in which they should be removed, and decontamination procedures. There should also be a documented fitting test for protective goggles and mouth-nose masks for each worker before work is begun. This practical instruction should be combined with the opportunity for farmers and other persons involved in combating an epidemic to receive training which incorporates current insights into infection risks.
10. The distribution of antiviral drugs in an AI crisis must be greatly improved and compliance with their use must be more effectively monitored.

5.2 Recommendations for psychosocial health, communication, treatment, and health-care needs

Recommendations for Objective 5: Inventorying the well-being and health-care needs of those involved

Psychological health complaints in poultry farmers

1. In future epidemics attention must also be given to farmers in supervised areas. They contend with nearly the same health complaints (stress, depression, and fatigue), restrictions, and need for support as do poultry farmers on cleared-out farms.
2. In future crisis situations, all relevant organizations (governmental and intermediary) can profit from better communication with target groups about possible health risks from infection and its prevention. This will increase awareness of the risks of infection. Teamwork, timeliness, and consistency are needed to stimulate maximal compliance with preventive measures by different target groups.

Material and financial care and support for poultry farmers

3. In a future epidemic there should be prompt and practical support dealing with questions of continuity of the farm and financial settlements. Present experience indicates that a positive and personal approach to those involved, as was provided in this epidemic by the RIC (later AIC) and SEP, can make an important contribution to successful support.
4. All parties in direct contact with those affected by the crisis should have good interchange of information and feedback about contacts with the affected.
5. The experience gained by the RIC should be incorporated in any revision of the IAC handbook. The initiative for this rests with the Association of Dutch Municipalities.

Recommendations for Objective 6: Recording and evaluating the experiences of those involved in the avian flu epidemic

Information about and preparation for the clearing out provided to the poultry farmers

6. In a future epidemic the affected poultry farmers should be informed with the same promptness as in the avian flu epidemic in 2003.
7. Very soon after initiating efforts to combat the effects of an animal disease crisis, it must be ascertained how the dissemination of information and the implementation of various activities by the government are proceeding. With this information the responsible crisis organizations can send whatever is necessary directly to where it is needed.

Information about and preparation for the clearing out provided to the professional groups

8. In a future epidemic the professional groups involved in the clearing out should be informed about and prepared for the methods to be used, because of the psychosocial impact of these activities.
9. After the clearing out, the RIC should make follow-up telephone calls to learn whether there is a need for supplementary information.

Treatment of and reactions from poultry farmers during the clearing out

10. The poultry farmers were in general satisfied with the manner in which they were treated by workers involved in activities to control the epidemic. It is important to continue investing in good treatment of the poultry farmers by the various professional groups. Respect, understanding, good communication, and pursuing cooperation prevent potential conflicts and promote cooperation by the poultry farmers.

Recommendations for Objective 7: collection of information relevant to optimizing the care and aftercare of those involved

11. Invest in accommodation and cooperation between agricultural and regular assistance agencies, making use of each other's expertise. Prevent unnecessary medicalization and clearly indicate where the poultry farmer should go for help for each kind of problem.

5.3 General recommendations

1. In the evaluation of the risks of AI infection for humans, consideration must be given to a greater potential area of dissemination for humans than for the affected poultry.
2. In order to improve the possibilities for health monitoring, reference values should be collected concerning the health and the risk factors for poultry farmers (and others) and for persons involved in combating an animal disease epidemic.
3. In any future investigation of livestock farmers and persons who carry out the actual work of clearing out in an epidemic, specifically applicable methods and infrastructure must be available to optimize the response.
4. A regulation should be prepared for the exchange of data concerning persons involved in animal disease crises and in the possible spreading of zoonoses. It should specify how rapidly and carefully (taking into consideration the WBP) relevant personal data can be exchanged between the owner of the data and those using the data. This is of importance for an adequate and rapid start of health investigation, monitoring, and provision of care, and/or protective or preventive measures.
5. Recording and information systems used in an animal epidemic should be better equipped to quickly and adequately provide insight into the numbers, contact data, work activities, and possible exposure of all persons (also those hired outside) who are involved in combating an animal disease epidemic.

6. Acronyms

AI	Avian Influenza
AID	General Inspection Services
BAO	Policy Decision Team
BSE	Bovine Spongiforme Encephalitis
DIAS	Document Information and Archive System
GGD	Municipal Health Service
GGZ	Mental Health Care
GOVE	Health survey Avian Flu Epidemic
HAT	Help Advice Team
ILI	Influenza Like Illness
IvP	Institute for Psychotrauma
LASER	Laser performs certain functions for ministry LNV
LCI	National Coordinating Structure Infectious Disease Control
LIS	Laboratory for Infectious Disease Diagnostics (RIVM)
LNV	Ministry of Agriculture, Nature and Food Quality
LTO	Agriculture and Horticulture Organization
MKZ	Foot and Mouth Disease
NIVEL	Nederlands Instituut voor Onderzoek van de Gezondheidszorg
NOP	Netherlands Organization for Poultry Farmers
OMT	Outbreak Management Team
PCR	Polymerase Chain Reaction (test)
RCC	Regional Crisis Center
RIC	Regional Information Center
RIVM	National Insititute for Public Health and the Environment
RNA	Ribonucleic Acid
RVV	National Inspection service for Livestock and Meat
SEBA	Social Emotional Support for Farmers
SEP	Social Economic Plan
VWA	Food and Consumer Product Safety Authority
VWS	Ministry of Public Health, Welfare and Sport
WBP	Privacy Protection Act