ABSTRACT Over the past 5 yr, the poultry industry in Canada has had a few H5 or H7 avian influenza (AI) epidemics. Analysis of these outbreaks by government officials highlighted the need to establish a better partnership between those responsible for controlling the disease and public health officials responsible for protecting the public and those participating in eradication efforts. These officials also agreed that compensations had to be reviewed, that national biosecurity standards needed to be established to better prevent AI, that a national mortality disposal plan was needed, and finally that the current emergency disease management protocols had to be reviewed. Industry representatives stressed the need for early detection and reporting; for more effective tools for decision making, including using local expertise for trace-back activities and quick interventions; for better communications within industry, but mainly between industry and governmental authorities at the federal, provincial, and municipal levels; and finally, for better planning to minimize the impact of eradication efforts on poultry production and for the recovery following the epidemic. These observations triggered a series of initiatives. A National Office of Animal Biosecurity was created by federal authorities, with the mandate to establish national biosecurity standards. A Canadian Animal Health Surveillance Network was also put in place to improve the capacity of early detection of the disease and to increase the surge capacity of the Canadian laboratory system. Wildlife and commercial poultry AI surveillance programs have also been put in place. Provincial poultry grower organizations have established AI control and eradication plans that are increasing their ability to intervene early and to assist government authorities once AI is confirmed in the field. This includes the creation of industry incident command centers with emphasis on confidentiality agreements between government and industry organizations and effective grower assistance before, during, and after an epidemic.

Key words: avian influenza, control, Canada

INTRODUCTION

Over the past 5 yr, the poultry industry in Canada has had 2 outbreaks of reportable highly pathogenic avian influenza (AI) and 1 case of low pathogenic AI identified in domestic ducks. These events are part of a growing number of H5 and H7 AI epidemics reported worldwide. In fact, about 60% of all highly pathogenic epidemics recorded in the world over the past half century have occurred in the last 15 yr (Alexander, 2007; Swayne and Halvorson, 2008). Similar events have also occurred in the United States, as well as an exotic Newcastle epidemic in 2002 to 2003 in the Southwest (Kinde et al., 2005). These events have triggered a flurry of initiatives by government and industry organizations. This paper will briefly present the circumstances in Canada and the resulting activities aimed at better preventing and controlling H5 and H7 AI in commercial domestic flocks.

Fraser Valley, British Columbia, 2004

Between February and May 2004, forty-two premises in the Fraser Valley of British Columbia (BC) had flocks considered infected with a highly pathogenic strain of H7N3. The eradication effort required the depopulation of 410 commercial poultry farms and 553 backyard flocks. The industry estimated that secondary revenue losses alone reached about $380,000,000 US. It took 2 yr for the industry to fully recover. Out-
of-pocket costs for allied industries were estimated at $63.3 million. Government compensations were limited to about $63.7 million (Bowes, 2007). Could this disaster have been prevented? It is not known how the index case got infected. But veterinary investigations at the time of the outbreak highlighted the importance of early diagnosis and reporting. Indeed, it started in a 52-wk-old broiler breeder flock on February 5. A sudden drop in feed consumption was noted with a slight increase in mortality and a 10% drop in egg production. The feed was suspected at first. On February 9, tracheas and lungs were submitted to the local provincial diagnostic laboratory. On February 13, PCR results indicated that it could be AI. Egg production was down a further 10%, but the problem seemed to be resolving clinically. On February 17, AI was isolated and federal authorities notified (Bowes, 2004; CFIA, 2004). The virus appeared to be of low pathogenicity. However, a day later, younger birds from another flock on the same farm started showing severe clinical signs compatible with highly pathogenic AI (Bowes et al., 2004). The farm was put under quarantine on February 18, and the Canadian Food Inspection Agency (CFIA) ordered depopulation the next day. Although the initial government actions appeared quick, the reality is that the virus was able to circulate for several days before governmental intervention. The AI control efforts that followed this initial case have been the object of several debates, publications, and presentations by government and industry professionals (Bowes, 2004, 2007; CFIA, 2004; Power, 2005). Although the epidemic was limited to the Fraser Valley in BC, many expressed the idea that more decisive actions early on could have minimized the size and duration of the problem. A series of committees and meetings analyzed what happened. In brief, reports from CFIA highlighted the need to establish a better partnership between those responsible for controlling the disease and public health officials responsible for protecting the public and those participating in eradication efforts. They also agreed that compensations had to be reviewed; that national biosecurity standards needed to be established to better prevent AI and any similar catastrophic events; that a national mortality disposal plan was needed; and finally that the current emergency disease management protocols had to be reviewed (Power, 2005).

The Poultry Industry Council, based in Ontario, sponsored the first public postmortem of the BC epidemic. From this meeting, a series of 11 lessons were retained (Table 1). Other participants or witnesses to the AI events in the country also came up with observations and suggestions. In essence, all stressed the need for early detection and reporting; for more effective tools for decision making, including using local expertise for trace-back activities and quick interventions; for better communications within industry, but mainly between industry and governmental authorities at the federal, provincial, and municipal levels; and finally, for better planning to minimize the impact of eradication efforts on poultry production and for the recovery following the epidemic.

**Fraser Valley, British Columbia, 2005**

In 2005, a low pathogenic H5 AI was found in BC through active surveillance in a few commercial duck flocks that were not showing any clinical signs. Seventy-eight commercial poultry farms within 5 km of the infected flocks were tested weekly for 21 d. They remained negative. Contrary to 2004, CFIA moved aggressively upon presumptive results from the provincial laboratory. Local expertise was used and better communications were established between the agency and the industry (Bowes, 2006). Although not as damaging economically to the poultry industry, it is worth noting that some duck farms located thousands of kilometers away elsewhere in the country are still not allowed to export to Mexico in 2008 because of this 2005 BC incident (C. Trottier, Canard du Lac Brome, Knowlton, Quebec, Canada, personal communication)!

**AI Surveillance in Waterfowls**

Since the events in BC, a decision was made to increase AI surveillance. Although the CFIA had the legal authority to initiate active surveillance in domestic

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### Table 1. Lessons learned from the 2004 avian influenza epidemic in British Columbia

<table>
<thead>
<tr>
<th>Number</th>
<th>Lesson</th>
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<tbody>
<tr>
<td>1</td>
<td>One person needs to be designated as the coordinator of the disease response, aided by an advisory committee</td>
</tr>
<tr>
<td>2</td>
<td>You don’t find it if you don’t look for it</td>
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<tr>
<td>3</td>
<td>Act quickly and decisively if a communicable disease is suspected</td>
</tr>
<tr>
<td>4</td>
<td>Delays in testing and response cause trouble</td>
</tr>
<tr>
<td>5</td>
<td>Industry involvement in decision-making is crucial from day one</td>
</tr>
<tr>
<td>6</td>
<td>Emergency response plans are needed by every municipality and every commodity group</td>
</tr>
<tr>
<td>7</td>
<td>Emergency protocols for the disposal of killed animals or birds and for contaminated manure must be detailed and in place</td>
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<tr>
<td>8</td>
<td>Clear ongoing communications with all stakeholders is vital</td>
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<tr>
<td>9</td>
<td>In the event of a disease outbreak, privacy legislation seriously hinders disease control</td>
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<tr>
<td>10</td>
<td>Every precaution needs to be taken to ensure that the disease is not being spread</td>
</tr>
<tr>
<td>11</td>
<td>The cleanup and disinfection after the outbreak must have a clearly defined set of requirements and specifically assigned and trained inspectors</td>
</tr>
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1From PIC (2004).
flocks, this agency met with strong opposition from the poultry industry because the federal compensation program was considered inadequate, particularly for breeders and egg layers because lost production was not compensated. So, the decision was made to initiate first a yearly waterfowl surveillance program. Waterfowls are known as the main reservoir of AI (Swayne and Halvorson, 2008). A national program was put in place with the monitoring of 6 regions (Alberta, Atlantic provinces, BC, Manitoba, Ontario, and Quebec). Except for Alberta, H5 AI viruses were identified by real-time reverse transcription-PCR in all the other regions (Parnley et al., 2008). Prevalence varied between 4 and 25% depending on the region.

**Saskatchewan, 2007**

In late September 2007, a 50,000 broiler breeder farm was confirmed infected with a highly pathogenic strain of H7N3 near Regina, Saskatchewan. This strain was different from the one associated with the 2004 epidemic in BC. No other commercial poultry operations were in the vicinity, and this remained an isolated case. An epidemiologic investigation concluded that the origin of the infection was likely waterfowls found on a lake a few kilometers from the farm. Saskatchewan was not included in previous waterfowl surveys. The exact way the virus gained access to the domestic birds is not known. They have been a significant source of viruses for turkeys in Minnesota and Wisconsin (Halvorson, 2002). Risk factors leading to these infections have included direct contact with juvenile migratory ducks and free-range turkeys and the use of AI-virus-contaminated lakes or ponds for turkeys raised indoors. However, in Saskatchewan, water from the suspected lake was not used by the infected commercial operation.

**Canadian Initiatives**

**Governmental Initiatives.** Many provincial governments have been working with the local poultry industry to produce training material on biosecurity. The CFIA has contributed financially to these efforts in the 3 main poultry producing provinces (Ontario, Quebec, BC). They are also assisting industry with poultry farm mapping. Although almost all poultry facilities have been included in geopositioning surveys, validation of the databases is not yet complete in some provinces.

The CFIA has also created a National Office of Animal Biosecurity. Currently, the main objective of this office is to produce, in collaboration with the Canadian poultry industry, national standards in biosecurity. This is a long process that covers on-farm and regional aspects of contagious disease prevention.

The CFIA has also established a series of AI working groups on the following topics: compensations, humane euthanasia, carcass disposal, and vaccination. The agency has created a poultry veterinary expert committee as well as a policy advisory committee on AI. The task of each group or committee is to support the ongoing development of the disease eradication plan of the CFIA.

One significant improvement has been the creation of a Canadian Animal Health Surveillance Network (CFIA, 2008). This network of federal, provincial, and university diagnostic laboratories is designed to improve the capacity to detect emerging animal disease problems in real time. This increases the surge capacity of the Canadian laboratory system, and results from certified labs can now be used for disease eradication efforts. By contrast, in 2004, only results from the CFIA Winnipeg laboratory were accepted, which created delays for those responsible for the eradication efforts in the field.

Other national initiatives include the constitution of a Canadian veterinary reserve similar to what is already in place in the United States. Over the past several months, veterinarians not necessarily associated with the poultry industry are participating in a 1-wk training program designed to prepare them in case a reportable disease outbreak occurs. For the time being, this training is done at CFIA’s facilities in Winnipeg, Manitoba.

The National Wild Bird AI Surveillance described above is still active. But in mid 2008, the CFIA has also initiated an active surveillance program in commercial poultry farms. Although compensation issues are still not resolved, the agency elected to go ahead with this program because it is essential to maintain poultry exports to the European Union. The program focuses on mature birds and is designed to meet all requirements prescribed by the OIE and the European Union (OIE, 2008; EU, 2008).

**Industry Initiatives.** Regional disease control is managed during 2 distinct periods: preepidemic and epidemic. Before a reportable disease is officially recognized in a region, poultry growers and related organizations can lead many interventions. Once the disease has been found and recognized, international regulations clearly state that federal government authorities are responsible for disease eradication. Hence, it is critical for poultry organizations to put in place a strategy designed to quickly intervene in case a reportable disease is suspected. It is also equally important to establish intervention strategies in collaboration with government authorities for situations when these governmental bodies have to intervene. For example, the AI epidemic in 2004 and a simulation conducted later that year in Ontario have shown that industry is in a better position to trace back on-farm traffic activities than government intervention teams. During the preepidemic period, surveillance and early reporting of suspected cases are critical aspects of the disease control strategy. Once the disease is confirmed present, industry resources must mobilize to support government interventions (including influencing government decisions) and to manage the impact of disease eradication activities.
In Ontario, grower organizations have created the “feather boards command center.” This center regroups all grower associations and is responsible for the development and implementation of disease control strategies. In Quebec, a similar organization was created, that is called the Quebec team for the control of poultry diseases. This team includes members of grower associations, but also members of allied industries, such as feedmills, slaughter plants, etc. (note that the poultry industry is not fully integrated in Canada). Veterinarians and members of academic institutions also collaborate. This team, like in Ontario, meets more or less regularly to develop, review, and evaluate disease control strategies. In Quebec, 3 groups were created as part of the disease control strategy (Figure 1):

1. Decision maker group: This group includes elected leaders of grower associations and a few directors of allied organizations (feedmills, hatcheries, slaughter plants). Other individuals support this group responsible for all main decisions in time of crisis. Using a structure similar to the “incident command system” developed in the United States, this group will handle issues associated with planning, operations, logistics, and finance.

2. Technical group: This group is currently responsible for the development and refinement of the disease control strategy. However, if an epidemic occurs, members of the group will be directly involved with operations in the field.

3. Communication group: This group is critical to activities before an epidemic (distribution of information to industry members, response to requests from journalists and political leaders, and establishment of information campaigns to inform consumers depending on international, national, or local events). For example, this group established an information campaign to explain...
the situation in Europe when cases of H5N1 AI were reported, but more importantly, to inform Canadian consumers about the level of risk to them. During an epidemic, the CFIA has a communication protocol that includes assisting with industry press releases. However, the Canadian poultry industry needs its own plan for internal and external communications.

**Assistance to Growers.** The Ontario and Quebec plans put emphasis on grower assistance. In Quebec, this includes the following:

1. Assistance before an epidemic: A help line is operational at all times. A communication scheme will also allow industry leaders to quickly communicate with all growers via fax and e-mails when a situation has changed or when specific instructions must be delivered. Finally, to obtain critical information quicker during a crisis, some of the information needed by government officials during an epidemic (e.g., type of production, other animal productions on the same site, etc.) will be collected beforehand.

2. Assistance during an epidemic: Growers whose farms are involved will get assistance from grower organizations. An emergency kit will provide all equipment and information for self-quarantine; at least one member of the organization will go on site to assist with inquiries by government authorities, and will help managing daily on-site needs while the grower is occupied with CFIA officials.

3. Assistance after the epidemic: This will include help to get compensation, assistance to restart operations, and even psychosocial help, if needed.

Signed agreements are being prepared with private companies and institutions in case assistance is needed. Although minimal storage may be required for products such as disinfectants, the vast majority of products and equipment will be made available “just in time” by companies signing these agreements. Agreements will also be signed with universities. Indeed, although they may have very limited financial capabilities for such events, they have facilities (rooms and communication equipment) and human resources that could be mobilized in case of an emergency.

**Training and Information Sessions.** Several training modules are being prepared to train poultry and allied industry personnel. Core training topics are biosecurity, including self-quarantine; reporting and communications; depopulation and carcass/products disposal; and cleaning and disinfection of affected premises. In addition to traditional educational programs, poultry industry members are also participating in simulation exercises (tabletop and field exercises).

**Impact Management.** Impact management is composed of all activities designed to mitigate the impact of disease control decisions. For example, how can we minimize the impact of closing down a slaughter plant? This requires planning before the situation arises. In Ontario, the largest feedmill representatives have agreed to coordinate activities. Therefore, if a feedmill is located in an infected zone (e.g., a 5-km zone around positive farms), this feedmill will be responsible to feed all flocks in this zone, including those of competitors. To do this, they have agreed on specific feed formulas designed to maintain flocks depending on each type of production in time of crisis.

Finally, the Ontario poultry industry currently works with other animal industries and insurance institutions to eventually offer coverage to growers to cover expenses not paid by the federal government in case of eradication, such as production losses. This is a significant undertaking that requires assessment of current biosecurity practices and compliance.

**Compartmentalization and Zoning.** When an important disease is identified, the standard operating procedure is to quarantine infected premises and to establish a restricted zone around them to minimize disease transmission, increase surveillance, and depopulate. An Ontario simulation in October 2004 has highlighted the magnitude of the challenge. It has also shown that bird movement before the index case has been identified forces the industry and governments to be reactive rather than proactive. In other words, the microbe and its initial spread dictate the infected and controlled zones and force us to follow its trail. Very little can be done to actually change this approach. We can only try to prepare so that the response can be fast and well coordinated. But how about the disease-free areas? Since the increase in major animal epidemics around the world, the concept of zoning disease-free areas has emerged. Currently, a few projects are under way or just being completed in Canada to determine whether any of these 2 strategies might be possible as part of AI control programs.

The OIE (2007) defines a compartment as “one or more establishments under a common biosecurity management system containing an animal subpopulation with a distinct health status with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.” A zone is “a clearly defined part of a country containing an animal subpopulation with a distinct health status with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade” (OIE, 2007). Compartmentalization is being considered by a primary breeding company in Ontario. A project is also conducted in the same province to determine whether it may be possible to use zoning. Essentially, the idea is to determine whether the province could be divided in at least 2 zones that could
operate independently of each other for a period of time when a disease like AI is suspected or confirmed. Preliminary results suggest that this could be feasible.

**Issues That Will Not Go Away: The Need for a New Paradigm.** A paradigm is “a set of common beliefs and agreements shared between scientists about how problems should be understood and addressed” (Kuhn, 1962). Unfortunately, any information that does not fit the paradigm is usually, at best, ignored. At worst, it triggers a very negative reaction. California experienced this when people with backyard flocks and live-bird markets started moving birds around (i.e., increasing bird traffic) during the effort to quarantine and reduce traffic to contain the Newcastle epidemic of 2003 (Kinde et al., 2005). For these people, the risk and impact of losing their birds or business was considered much greater or important than the risk and impact of spreading a very virulent virus throughout the community. In the 2004 AI simulation in Ontario, this behavior was a consideration in delaying regional traffic control. The concern was that any initial effort by the poultry industry to control traffic (other than to restrict the movement of industry vehicles) could spark a flurry of activities by noncommercial growers, and even some commercial growers, who could elect to send birds to slaughter sooner to avoid an upcoming federal quarantine. Poultry production is currently seen as a mechanical process largely determined by economics. A new paradigm is needed that should include health risks and welfare as core components. This will necessarily bring the need to develop a regional perspective to poultry production and disease control. This is important to change people’s attitude regarding several issues that are essential to regional disease control and that simply will not go away.

A recent series of simulations in Ontario, Quebec, and New Brunswick have highlighted these issues. They are very similar to the lessons learned from epidemics. They are the following:

- the critical importance of an early reporting system,
- confidentiality issues,
- signed agreements to allow effective communications between industry and governments,
- the mapping of all farms with basic information (type of production, size of farm),
- adequate diagnostic capabilities,
- the availability of funds to initiate an early response,
- the availability of trained human resources,
- having a coordinated industry central command, and
- knowledge about sales barns or other points of sales for small scale flocks.

**Early Reporting.** The best disease eradication plan will be worthless unless the location of infected (or potentially infected) premises is known quickly. Therefore, conditions must favor reporting by growers. They must be informed of the need to report any suspected cases, and they must know who to contact. Of course, this is not enough because most growers will hesitate to declare their farm infected unless they are convinced that the economic impact will be less than if they stay quiet. Hence, information sessions are needed to explain the economic value of early interventions. Second, any communication between a grower and individuals associated with disease eradication must remain confidential as long as the case has not been confirmed. A good early detection system will necessarily lead to false positives. Therefore, to avoid any economic impact under such circumstances, it is essential that the investigation of a potential case remains as discreet as possible. Finally, growers must have incentives to report early. These incentives can be positive or punitive. Positive incentives may include quick assistance to growers, financial aid, and priority for repopulation once the disease is under control. Punitive incentives could include limitations on production capacity (note that a quota system is in place in Canada to manage poultry production; at least one marketing board in Ontario will cut production capacity to a grower who does not report excess mortality as defined by this board), lower compensations, and loss of priority for repopulation (i.e., growers reporting early would be repopulated sooner than those not doing so). These incentives and others have yet to be debated. As always, financial considerations are the most controversial issues.

**Communication.** Key industry leaders and decision-makers from local governments must receive the epidemiological information needed to act quickly if an epidemic emerges. Geographical information systems are fast becoming routine tools out of the necessity to quickly determine the location of infected or diseased flocks. However, geographical information systems require accurate, up-to-date data to be of value. Each farm, company, or organization in a region needs to comply. Whoever is charged with maintaining the geographical information system in a specific region (e.g., a province) also needs to communicate effectively with all participants to preserve the integrity of the system.

**Confidentiality.** The Quebec and Ontario plans require a high degree of confidentiality when exchanging information on specific farms. Privacy laws and professional ethics (veterinarians and agronomists) make it very hard for early interventions unless all parties involved have agreed to the exchange of information. The solution for one grower organization has been to request a signed letter from each grower preauthorizing the limited exchange of information between key emergency measures officials under specific circumstances. The concept is to create a bubble of confidentiality where a select number of people are informed of a potential case to initiate some actions (quarantine, delays in bird pick up or delivery, redirecting of poultry traffic, etc.) pending laboratory results.
Conclusions

The emergence and reemergence of important contagious diseases in the poultry industry is not a new phenomenon. However, the increased regional density of poultry production requires that we prepare differently than in the past. No one organization has the resources to manage an important epidemic. Therefore, emphasis must be on collaborating efforts and on preemptive actions designed to tackle an epidemic very quickly. This requires a lot of preparation and leadership on the part of governments and the poultry industry. Recent events have triggered many initiatives. The challenge will be to complete and maintain them, even if no more AI outbreaks are identified in the coming years.

REFERENCES