Ontario Animal Health Surveillance Network

"Conducting surveillance as a partnership to improve animal and related public health in Ontario."

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Note: Every reasonable effort is made to ensure that the information included in this report is accurate. However, it's subject to change without notice as new information comes to the attention of the OAHSN.
Executive Summary

- Surveillance of animal health is important to support safe trade of livestock, animal products and foods of animal origin.
- Surveillance of animal health is also important to public health.
- Ontario has a strong network of professionals in veterinary science, animal health, food inspection and extension education. This infrastructure can be thought of as an Ontario Animal Health Surveillance Network (OAHSN).
- This report summarizes the infrastructure and surveillance coverage achieved by OAHSN and describes some activities of core network members.
- The Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA) and the University of Guelph provide core members to OAHSN. This core group has veterinary specialties in epidemiology, pathology, animal health, outbreak investigation, technology transfer, outreach, food inspection, and research. These core members maintain links to other disease surveillance networks in Ontario at the interprovincial, national and international levels. Core members co-ordinate surveillance functions - from diagnosis to data interpretation to follow-up actions.
- Objectives of the OAHSN core group include:
  1) Continuous improvement of the Ontario Animal Health Surveillance Network to help give people confidence in Ontario livestock, animal products and foods of animal origin;
  2) Refinement of an early warning system for trends of animal diseases and their determinants in Ontario;
  3) Improving methods to link animal health, food safety and public health information;
  4) Conduct or co-ordinate specific investigative, corrective and preventive steps relevant to the work of OAHSN.

Buyers, producers, processors and consumers can have confidence in the health and safety of Ontario livestock, animal products and foods of animal origin, partially due to OAHSN and the day-to-day work of partners in the broad network. The network has a mission to conduct surveillance as a partnership using information from government, academia, industry and private organizations to improve animal and related public health in Ontario.
Introduction and Objectives

Background & Introduction

Surveillance of animal health is increasingly important to food safety, related public health and the trade of animals and animal products. Confidence increases in the health of livestock and products from animals when there is a systematic way to demonstrate freedom from, or control of important diseases. The maintenance of agriculture and safe trade, both within and beyond the borders of Ontario, is also important to our well being in Ontario. The sale of livestock and animal products and the value-added through further processing, contribute over $10 billion to the economy and employ over 100,000 people in Ontario. At any time, a zoonotic public health incident can occur or agriculture can be severely damaged from an outbreak of disease in livestock. International examples include the devastating impact of bovine spongiform encephalopathy (BSE or "Mad Cow Disease") in the UK, hog cholera in The Netherlands, and the recall of 25 million pounds of hamburger in the U.S.A. because of contamination with E. coli O157:H7 bacteria. Diseases of lesser notoriety can also cause millions of dollars damage to regional economies as result of damage to trade, as well as animal and public health costs.

The Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA) recognizes the importance of animal health to the economy. OMAFRA and the Laboratory Services Division (University of Guelph) have dedicated resources to animal health surveillance by allocating staff as core OAHSN members, base operating funds and special investigative and outreach resources.

The objectives of this report are to: 1) describe the strength of the network involved in animal health surveillance in Ontario, 2) summarize the surveillance coverage of livestock in Ontario, and 3) illustrate the confidence the public can place in the health of livestock and the quality of animal products from Ontario.

Surveillance Objectives & Schematic Framework

The overall objectives of the Ontario Animal Health Surveillance Network (OAHSN) are:

1) To use a network of people involved in animal health, food inspection and extension education to continuously improve surveillance of animal health in Ontario;

2) To interpret animal health data and contribute to appropriate follow-up actions to improve livestock animal health;
3) To link, summarize, interpret and **act upon data that connects animal health, food safety and public health** using a broad network of partners;

4) To raise awareness and **reduce the risk of threats to animal health from beyond Ontario's borders**;

5) To **support animal health surveillance of the national government**, to maintain and demonstrate the health of Canadian livestock.

These objectives are achieved through the active maintenance and enhancement of early warning systems for animal disease trends linking animal health, food safety and public health, through a network of partners. **This network meets the requirements of the Office International des Epizooties (OIE), as identified in the Sanitary and Phyto-Sanitary (SPS) sections of the World Trade Agreement (WTO) and the North American Free Trade Agreement (NAFTA).**

Figure 1 summarizes the **cyclical flow of animal health data, information, appraisal and follow-up that comprises the surveillance work** of the Ontario Animal Health Surveillance Network (OAHSN).

**Figure 1: Schematic diagram of surveillance work of OAHSN.**
The following text sections describe the surveillance infrastructure, coverage and activities of the OAHSN and its core group.
Ontario Animal Health Surveillance Network

Veterinary & Animal Health Infrastructure

The **OAHSN** strives to achieve its objectives by coordinating specific information and risk management activities related to **animal health surveillance through an infrastructure of individuals, organizations, systems and programs**, as follows:

**Veterinary Science Infrastructure**

In January 1999 there were 3,086 individuals licensed to practice veterinary medicine in Ontario. The licensing body, the **College of Veterinarians of Ontario (CVO)**, maintains records of the primary professional activity of veterinarians. There were 691 veterinarians working in livestock medicine, 202 employed by government, and 101 Ontario veterinarians listing research as their primary activity.

The **Ontario Ministry of Agriculture Food and Rural Affairs** provides veterinarians for surveillance work (such as outbreak investigation, extension education, epidemiology, food safety, inspection) in the **Veterinary Science** group in Fergus, and through the **Food Industry Division** and **Research and Corporate Services Division** in Guelph, Ontario.

The **Animal Health Laboratory (AHL)** of the University of Guelph serves as a system of veterinary diagnostic laboratories that are supported in part by public funding. This system provides full-service diagnostics for Ontario livestock producers and generates expert surveillance data. Its laboratories are located at three sites across the livestock regions of Ontario, providing diagnostic and consulting services for veterinarians and livestock owners. The laboratories are fully accredited by the American Association of Veterinary Laboratory Diagnosticians (AAVLD) and are staffed by 17 professional and 62 technical specialists in veterinary pathology, microbiology (including Mycoplasma spp), immunology / serology, virology, parasitology and toxicology. There are also several private veterinary laboratories in Ontario that provide basic microbiology and specific serologic and molecular biology testing of livestock samples.

The strength of the publicly funded **outbreak investigation-consultation-extension unit comprised of Veterinary Science - OMAFRA and the Animal Health Laboratory (U of G)** is unique and provides an important service to agriculture and the public of Ontario. This service becomes even stronger when put in collaboration with outbreak investigation capability of the Ministry of Health and Long Term Care, Health Canada and the Canadian Food Inspection Agency.

The main campus of the **University of Guelph**, including the **Ontario Veterinary College (OVC)** and the **Ontario Agricultural College (OAC)** is located in Guelph Ontario. This institution is world famous for its expertise in teaching and research in veterinary medicine, animal science and food science. In March of 1999 the OVC had...
94 professional faculty and 165 technical and support staff providing veterinary teaching, diagnostic and research activities (including a veterinary teaching hospital), among 400 undergraduate and 130 graduate students. The OVC also offers courses in continuing education for veterinary practitioners. At the annual renewal of licenses to practice, veterinarians can document the time they committed to continuing education during the previous year.

Sub-groups of veterinarians that share similar interests in livestock medicine have been organized within Ontario such as the Ontario Association of Bovine Practitioners (OABP), the Ontario Association of Swine Practitioners (OASP), and the Ontario Association of Avian Practitioners.

Communications

To facilitate communications, sample shipment and information flow (including ease of access to information, laboratories and specialists etc.). It should be noted that Ontario is essentially fully covered with telephone, electronic paging, facsimile, postal and private courier services. Electronic mail is available throughout most of the province. To facilitate face to face meetings, many veterinary, food inspection, animal agriculture, service and research organizations are located in or near Guelph Ontario, including, for example: OMAFRA headquarters, AHL, OVC, OAC, CVO, Canadian Food Inspection Agency (CFIA, regional headquarters), Health Canada - Health of Animals Laboratory, the Canadian Animal Health Institute, Dairy Farmers of Ontario, the Dairy Herd Improvement corporation, Ontario Cattlemen's Association, Ontario Pork, Ontario Broiler Hatching Egg & Chick Commission, the Poultry Industry Council etc. Core members of the OAHSN also communicate with and participate directly in various national committees such as the Canadian Animal Health Consultative Committee (CAHCC), the Canadian Animal Health Surveillance Network (CAHnet - coordinated by epidemiologists within the Animal Health Division of the Canadian Food Inspection Agency). Also, core members of the OAHSN subscribe to pertinent computerized list-servers on the Internet, to track emerging animal health issues internationally (e.g. ProMED, EpiVet-L, FSNet, AgNet, and AnimalNet), and routinely receive electronic international alerts from the Office International des Epizooties (OIE) through the Canadian Food Inspection Agency.

Animal health information is also communicated through:


**Animal Health Laboratory Newsletter** of the Laboratory Services Division, University of Guelph ([www.uoguelph.ca/labserv/ahl](http://www.uoguelph.ca/labserv/ahl)) *(link to external sites - disclaimer)* and the CAHnet Bulletin of the Canadian Animal Health Network of the Canadian Food Inspection Agency ([www.cahnet.org](http://www.cahnet.org)). *(link to external sites - disclaimer)*

Animal Health Monitoring and Food Inspection Systems

In Ontario, all commercial animal sales-yards, abattoirs, dead-stock and rendering operations must be licensed with either the Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA), or the Canadian Food Inspection Agency (CFIA). This results in essentially complete licensing control, inspection coverage and veterinary access to all animals moving through commercial sales-yards, and abattoirs, and access to dead-stock and rendering establishments.
In Ontario, all animals and carcasses slaughtered and dressed at all commercial abattoirs must be inspected by third-party inspectors, employed or contracted by OMAFRA or CFIA. Unlike some jurisdictions, **there are no exemptions from antemortem and postmortem inspection**. All animals or carcasses suspected as being diseased are referred for veterinary consultation. In federal establishments, a resident veterinarian conducts an inspection and makes the appropriate carcass disposition. In provincially licensed abattoirs, the inspector phones a staff veterinarian and if deemed necessary, a locally appointed licensed veterinarian is brought in for final disposition. If required, samples are submitted to a veterinary diagnostic laboratory for confirmatory testing. Approximately 336 inspectors (198 federal, 138 provincial) and 163 veterinarians (47 federal, and 116 provincially appointed) serve full or part time in this role in Ontario.

A good example of systems that link animal health, food safety and product quality data are the dairy testing programs for somatic cell counts (SCC) and anti-microbial residues in milk. In Ontario, random milk samples from all dairy farms are tested for SCC and anti-microbial residues. This amounts to over 200,000 tests per year conducted at the University of Guelph for the Dairy Farmers of Ontario. In addition, over 90% of all tanker-truck loads are tested for anti-microbial residues before being off-loaded at dairies. Any suspect loads are held pending confirmatory and trace-back testing of all farm bulk-tanks that contributed to the suspect load. These data are monitored by the OAHSN for unusual trends. Dairy Farmers of Ontario milk quality staff follow-up with on farm investigations.

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OAFRA supports animal health in Ontario and commits resources to the core of the Ontario Animal Health Surveillance Network (OAHSN). The mission of OAHSN is to conduct surveillance as a partnership to improve animal and related public health in Ontario. The network is led by Ontario's Provincial Veterinarian. The core group includes specialists in veterinary epidemiology, pathology, meat inspection and electronic data management. Appendix II identifies the core members of the OAHSN, their affiliations, work areas and contact numbers. The group has direct communications links to animal industry, veterinary practice, laboratory, meat inspection, research, extension education and policy, individuals and organizations, at the provincial, national (such as CAHnet) and international levels. These linkages help co-ordinate core surveillance activity related to animal health in Ontario. And these linkages complete the overall Ontario Animal Health Surveillance Network. The overall objectives of the OAHSN are stated in Section 2.2 of this document.
Ontario Animal Health Surveillance Network

Surveillance Coverage of Livestock Populations At Risk

The following sections describe surveillance coverage of livestock populations at risk of disease in Ontario. Appendix III summarizes the data in table format.

**Dairy Cattle**

All farmers that produce and sell bovine milk or cream in Ontario must be licensed by an independent organization known as the Dairy Farmers of Ontario (DFO). There were 6,778 producers selling milk to the DFO in September 1999. Ninety-five percent of dairy herds are geographically located in southern Ontario, especially southwestern and eastern Ontario. Although the average size of dairy herds in Ontario is approximately 50 cows, DFO quota statistics suggest that approximately 20% of mature dairy cows are located within 5% of the herds.

In Ontario, 201 abattoirs (2 federally inspected, 199 provincially inspected) slaughtered dairy and beef cull cows. All of these animals underwent ante-mortem and post-mortem inspection.

There are 46 livestock auction markets licensed and under veterinary inspection in Ontario. Reports from veterinary inspectors under contract with OMAFRA, are monitored by the OAHSN for unusual trends.

The Animal Health Laboratory system of the University of Guelph in Ontario generates surveillance data from specimens from dairy herds. These data include specimens from full laboratory necropsy case-work-ups on dairy-breed cattle by full-time AHL veterinary pathologists, plus sample submissions from private veterinary practitioners. It is estimated that these diagnostic submissions originate from approximately 4,600 Ontario dairy farms per year dispersed throughout the province (see the map in Section 5).

**Beef Cattle**

The Statistical Services Unit of OMAFRA reported that there are approximately 14,172 beef farms in Ontario with a total of 1,628,000 beef animals and calves.

In Ontario, 216 abattoirs (9 federally inspected, 207 provincially inspected) are licensed to slaughter beef
animals in Ontario. All of these livestock underwent ante-mortem and post-mortem inspection by federal or provincial inspectors.

There are 46 livestock auctions markets licensed in Ontario, all under veterinary inspection. Reports from these veterinarians on livestock that were refused sale due to health concerns or other reasons are monitored by OAHSN core members for unusual trends.

The Animal Health Laboratory system of the University of Guelph in Ontario generates surveillance data from specimens from beef herds. These data include specimens from full laboratory necropsy case-work-ups on beef-breed cattle by full-time AHL veterinary pathologists, plus sample submissions from private veterinary practitioners. The OAHSN estimates that these diagnostic submissions originate from approximately 1,000 beef cattle herds per year.

Swine

There are approximately 5100 swine farms that market about 4,600,000 hogs in Ontario.

In Ontario, 204 abattoirs (3 federal, 201 provincially inspected) are licensed to slaughter swine. These establishments slaughter market hogs, BBQ hogs, cull sows and boars. All of these animals underwent ante-mortem and post-mortem inspection.

There are 46 livestock auctions markets licensed in Ontario. Sows, feeder, stags, boars and market pigs are sold through these sales markets, under veterinary inspection. Reports from these veterinarians are monitored by the OAHSN for unusual trends.

The Animal Health Laboratory, University of Guelph generates expert surveillance data on swine submissions. These data include specimens from full laboratory necropsy case-work-ups by full-time AHL veterinary pathologists, plus sample submissions from private veterinary practitioners dispersed throughout the province.

The OASHN is linked to the Ontario Swine Health Information Plan run by Veterinary Science - OMAFRA. This program determines the health status of 75 swine breeding herds in Ontario. A minimum of 4 herd health visits are conducted per year under this health plan by OMAFRA Veterinary Science veterinarians and private practitioners. Quantitative assessments of biosecurity, health, medications and vaccinations are conducted. Health status is determined by sampling and laboratory testing twice per year for \textit{M. hyopneumoniae}, \textit{A. pleuropneumoniae}, PRRS, Atrophic Rhinitis and clinical inspection for mange, TGE and dysentery.

Traditional Poultry

There are approximately 2,000 commercial poultry farms in Ontario, with a total of approximately 35,597,000 birds, including all classes of chickens and turkeys. These farms include 1,100 broiler producers; 490 table-egg producers; 168 turkey producers; 86 independent broiler-breeder producers; and 2 primary breeders in Ontario.

Much of poultry production in Ontario is done under various contract arrangements among different combinations of producers, breeding companies, feed companies and processors. Many of these organizations
either directly employ or have retainer contracts with veterinarians who specialize in poultry practice. Within this well-organized industry, essentially all commercial breeder, multiplier and production poultry flocks are closely monitored for variations in health and production. Exceptions to this general rule may include small operations involving a few laying hens, meat, or "fancy birds" (the latter are often raised for show purposes). It is important to note that the AHL keeps its sample submission fees low, to encourage this latter group to submit samples. This assists in health surveillance of this group, and is important to the maintenance of the international health status in the larger commercial industry.

The Ontario Hatchery and Supply Flock Policy (OHSFP) provides monitoring and testing in Ontario that meets the national Canadian Pullorum-Typhoid and Hatchery Sanitation requirements, and the US National Poultry Improvement Program. The OHSFP includes mandatory testing for *Salmonella pullorum*, *S. gallinarum* and other paratyphoid infections, and can include additional testing for *Mycoplasma gallisepticum*, *M. synoviae*, and *M. meleagridis* (turkeys).

There are 79 abattoirs (14 federally inspected, 65 provincially inspected) were licensed to slaughtered poultry in Ontario. All slaughter lots underwent ante-mortem and post-mortem inspection.

The Animal Health Laboratory of the University of Guelph generates surveillance data from poultry. These data include specimen examinations from full laboratory necropsy case-work-ups on traditional poultry, by full-time AHL veterinary avian pathologists, plus sample submissions from private veterinary practitioners.

The Poultry Industry Council, OMAFRA, and the University of Guelph have recently collaborated to create a critical mass of poultry health expertise that includes a new Health Management Veterinarian, a Pathobiologist and a Veterinary Epidemiologist. This will strengthen Ontario's capability in surveillance, technology transfer, diagnostics and related research in poultry.

Small Ruminant

There are approximately 200,000 sheep, lambs and goats in Ontario.

There are 191 abattoirs (3 federally inspected, 188 provincially inspected) were licensed to slaughter small ruminants in Ontario. All of these livestock underwent ante-mortem and post-mortem inspection.

There are 46 livestock auction markets licensed and under veterinary inspection in Ontario. These data are monitored for unusual trends.

The Animal Health Laboratory of the University of Guelph generates surveillance data from small ruminant submissions. These data include specimen examinations from full laboratory necropsy case-work-ups by full-time AHL veterinary pathologists, plus sample submissions from private veterinary practitioners.

Equine

Survey work by Dr. R. Wright of Veterinary Science - OMAFRA and the equine industry estimated that there are 293,000 horses in Ontario.
One abattoir is licensed to slaughter horses in Ontario, and it is federally registered. All horses slaughtered at this abattoir undergo antemortem and postmortem inspection.

There are 46 livestock auction markets licensed and under veterinary inspection in Ontario. These data are monitored for unusual trends.

The Animal Health Laboratory of the University of Guelph generates surveillance data on equine specimens. These include full laboratory necropsy case-work-ups conducted by full-time AHL veterinary pathologists, plus sample submissions from private veterinary practitioners.

Alternative Livestock

The raising and marketing of alternative livestock and products such as cervids, ratites and wild boar are becoming increasingly popular in Ontario. All such animals slaughtered for commercial purposes in Ontario, undergo ante- and post-mortem inspection at provincial or federally inspected abattoirs. Also, "fish farming" (aquaculture) is growing in importance. OMAFRA has extension personnel dedicated to such alternative livestock, and the AHL (University of Guelph) has pathologists available for such species.

Dead-Stock

There are currently 24 licensed dead-stock collectors in Ontario. These businesses submit data to OMAFRA, indicating the number of each species they collect each month. These data are monitored for unusual trends. As an example, in 1998, the following dead-stock were collected: 35,565 cattle (dairy and beef); 75,375 calves; 200,750 swine; 368 small ruminants; and 2499 horses.

The next sections illustrate some examples of surveillance activities in Ontario.
Ontario Animal Health Surveillance Network

Examples of Surveillance Activities in Ontario

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| Dairy health surveillance piggy-backed on farm financial programs |
| Geographic information systems - progress for surveillance |
| Production loss in layer flocks |
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| Post weaning multisystemic wasting syndrome of swine |

5.1 Bovine Virus Diarrhea

The estimated prevalence of herds experiencing BVD problems is now returning to relatively low levels seen in 1990-1992 (see graph below). OAHSN continues to monitor monthly patterns of BVD diagnoses in the Animal Health Laboratory, among veterinary practitioners and other relevant surveillance data. OAHSN partners conduct appropriate extension, outbreak investigation and recommend preventive steps to producers. Surveillance data from rendering facilities, community livestock sales, private practitioners and diagnostic laboratories helps to quantify, track and alert cattle industries to the increased risk of BVD in Ontario. During the epidemic in 1993-94, multiple sources of surveillance information led to widespread extension education activity and a marked increase in vaccination for BVD by 1994-1995.
5.2 Dairy health surveillance piggy-backed on farm financial programs

In 1995, 1996, and 1997 health and health management questions were added to the input forms of the Ontario Farm Management Analysis Project (OFMAP) for 200-500 dairy herds. These data were summarized for veterinarians to help their dairy clients "benchmark" their herd health as compared to provincial estimates for clinical mastitis, lameness, milk fever and calf mortality. Epidemiological analyses indicated that these disease events often cluster in herds, and certain management factors are associated with lower rates of these problems. These results were included in personalized reports for the participating producers and summarized in farm magazines, newspapers and Veterinary Science newsletter "Ceptor - Animal health News". Further analyses of these OFMAP surveillance data are ongoing. Health questions were added to the Ontario Dairy Farm Accounting Program in 1998 and 1999-2000 generously supported by the ODFAP staff and the Dairy Farmers of Ontario. A sample of the results from this work is included in the two articles on dairy herd health and sentinel herds below.

Dairy herd health report card

Herd health data were collected from 482 dairy farms in 1995 and from 383 farms in 1996 while conducting Ontario Farm Management Analysis Project visits. This information may help veterinarians carry out diagnostics with dairy producer clients.
From two years combined data, the average number of milking cows was 51 (range = 14 - 206). The average SCC was 204,000 (range = 49,000 - 600,000) and milk production was 3,711 hL (range = 852 - 17,567). The cost per dollar of production was $0.66 (range = 0.33 - 1.84). Based on these data the herds in this survey were judged to be representative of the industry in Ontario.

Table 1 below provides benchmark values for some important herd health factors and production limiting diseases. The percentiles indicate the percentage of herds that fall below that given value. For example, the average number of cases of clinical mastitis per 100 cows per year was 24, but 25% of the herds had fewer than 10 cases and 75% had fewer than 34.

Table 1: Dairy herd health survey 1995 - 1996

<table>
<thead>
<tr>
<th>Cases/100 cows/year</th>
<th>Average</th>
<th>Range</th>
<th>25th Percentile</th>
<th>75th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastitis</td>
<td>24</td>
<td>0-100</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>Milk Fever</td>
<td>6.3</td>
<td>0-67</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Downer Cows</td>
<td>4.4</td>
<td>0-73</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Lameness</td>
<td>10.5</td>
<td>0-98</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Abortions</td>
<td>3.3</td>
<td>0-25</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Culls</td>
<td>26.6</td>
<td>3-72</td>
<td>19</td>
<td>35</td>
</tr>
<tr>
<td>LDA</td>
<td>2.6</td>
<td>0-19</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Strawberry Foot Rot</td>
<td>7.4</td>
<td>0-96</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Heifer mortality averaged 11.5% (range = 0 - 100) with 25% of herds less than 6% and 75% of herds less than 17% mortality. Only 7% of farms kept livestock medicines in a locked storage area. Lameness rates were significantly greater for free-stall herds as compared to tie-stall operations based on logistic regression models adjusting for the random effect of region of Ontario. Dairy producers should be aware of these increased risks when converting to free-stalls.

Only 1.4% of producers reported a veterinary diagnosis of Johne's Disease within the previous 10 years. However, 7% were either unsure or unaware of the disease. Because of the growing significance of Johne's in issues of trade and possibly public health, further education and improved surveillance for this disease may be warranted. The survey is ongoing and results will be updated periodically in CEPTOR newsletter of Veterinary Science of OMAFRA.

Paul Innes and David Alves, Veterinary Science; Al deJong, and Farm Business Management Specialists OMAFRA

First results from sentinel dairy herds for 1998

Previous issues of CEPTOR (the newsletter of the Veterinary Science group of OMAFRA) reported some benchmarks of important diseases from kitchen-table health surveys conducted in about 300 dairy herds in 1995 and 1996. In 1998, we asked a random sample of 97 producers on the Ontario Dairy Farm Accounting
Program of the Dairy Farmers of Ontario a few questions about dairy health and determinants of herd health. We appreciate ODFAP staff for their contributions to this surveillance work.

No herds reported a veterinary diagnosis of abortion due to Neospora sp. This may indicate that, despite serological evidence in Ontario dairy herds, the true level of important clinical episodes of neosporosis occur in less than 3% of dairy herds each year. Further validation of this estimate is ongoing using multiple sources of data, as well as a research project at the Ontario Veterinary College.

Only 4% of herd owners indicated they had a veterinary diagnosis of Johne's disease in the previous 10 years. This is consistent with the previous time we asked this question of 300 dairy producers in Ontario. There appears to be some improvement in the understanding of this disease. In 1998, only 2% of producers indicated they did not know about Johne's disease whereas, in 1995, about 25% of producers could not answer this question.

Nearly all (97%) dairy herds were visited by a veterinarian in 1998. On average dairy farms have 4.4 emergency veterinary visits per year and 11.8 non-emergency visits per year. This statistic is of value for market access and trade. It provides current surveillance information when other countries ask about the coverage of Ontario dairy herds with veterinary service.

In this sample, 27% of Ontario producers are using a TMR mixer in their herds. In addition, 33% of owners are planning to expand; 17% were unsure about expansion; and 50% were not planning to expand their herds within the next five years.

David Alves and Melisa Kakuda - Veterinary Science OMAFRA; Jim Hanmore - ODFAP

5.3 Geographic Information Systems - progress for surveillance

Progress is being made to link databases to permit mapping of surveillance data at the postal code and township level using geographic information systems software. The map below demonstrates the coverage of the cattle areas of the province by private veterinarians who routinely use the three regional laboratories of the Animal Health Laboratory of the University of Guelph for full service diagnostics. This helps to illustrate the broad reception of surveillance data by these regional laboratories.
This investigation was a good example of the surveillance network using outreach and epidemiology from Veterinary Science of OMAFRA and diagnostics from the Animal Health Laboratory of the University of Guelph. From April 1998 to May 1999, 11 layer flocks in southwestern Ontario reported unexpected production loss that persisted throughout the lay period (see Figure 1 below). The flocks experienced a significant decrease (5-15%) in egg production at a mean of 53 weeks of age (range 37-70 weeks) which continued until the end of lay. Owners reported misshapen eggs occurring in 7-10 day cycles, with normal eggs between these periods. The cases were statistically clustered in a relatively small region in southwestern Ontario.
Diagnostic laboratory records were used in a case-control approach to conclude the most likely diagnosis in these flocks was infectious bronchitis virus (IBV). Genome studies showed two viral isolates from affected flocks to be distinct from Ontario isolates previously analyzed and virus neutralization indicated cross-neutralization with antiserum to the Connecticut and Arkansas DPI serotypes, and no significant neutralization with antiserum to Massachusetts serotypes. Recommendations from this investigation have resulted in: extension work to change local vaccination protocols in layers; biosecurity discussions at poultry industry meetings; increased awareness about IBV in layers; the need for ongoing genomic surveillance of IBV isolates; and follow-up exposure studies with the unique serotypes isolated. Recently, placements of sentinel birds are providing more insight into Ontario IBV isolates.

David Alves and Paul Innes (Veterinary Science - OMAFRA), Beverly McEwen and Doug Key (Animal Health Laboratory - University of Guelph)
5.5 Modeling the impact of redistributing test positive heifers in Ontario

Export testing and redistribution of test positive dairy heifers in Ontario - A computer simulation risk assessment

W. Bruce McNab, Neil G. Anderson and David M. Alves
Ontario Ministry of Agriculture Food & Rural Affairs

The export contract for dairy heifers is often conditional on negative test results for endemic diseases such as bovine virus diarrhea, paratuberculosis and neosporosis. The contracts may lead to the retention and often redistribution of test positive animals within Ontario. This report describes computer simulation work to assess the long-term risk to Ontario dairy herds following redistribution to non-source herds.

An Ontario livestock export agent provided information for the model. The information included the types of testing requested in contracts, estimates of the number of animals and herds, the rate of test failure, and the rate of return of test-positive heifers to their herd of origin vs. redistribution to other Ontario herds.

A computer model was written in visual basic to run a large macro in Microsoft Excel'97 in conjunction with Palisade's @Risk simulation software. A typical 5-year simulation was run 1000 times for a generic disease using 7000 dairy herds at risk in Ontario and annual export shipments varying from 20,000 to 30,000 heifers. The between-herd prevalence varied from 5% to 25% at the start of each of the 5-year simulations. The number of test-negative animals exported from any herd ranged from 1 to 15. The within-herd prevalence varied from 10% to 30%. The probability of a test-positive animal going to a different (non-source) herd in Ontario ranged from 10% to 35%. The probability of a previously negative herd becoming infected, as a result of receiving a test-positive animal, was allowed to range from 75% to 99%.

Under the above input conditions, the simulation results were as follows. The number of newly infected herds ranged from 400 to 1350 with a mode of 950. The between-herd prevalence increased from an initial range of 5 to 25%, to a range of 12 to 43% after five years. The model suggests that we might expect 925 previously negative herds could become infected after five years as a result of these redistribution practices. From the upper end of the distribution, the model suggests that we may be 95% confident that no more than 1175 such herds will become infected. The model also suggests this number can be markedly reduced with improved herd biosecurity.

These are preliminary results only and the model is undergoing refinement. Nonetheless, early results indicate that there can be a significant impact to our dairy industry when we redistribute a relatively small proportion of test-positive animals in the provincial herd subsequent to export testing and when biosecurity is not maintained.

5.6 Pilot project to assess antimicrobial resistance in Ontario livestock

Antimicrobial Resistance Among Bacterial Isolates from Food Producing Animals in Ontario. B. McEwen¹, N. Smart¹, C. Poppe², M. Neale¹, M. Archambault¹, A. Valdivieso², D. Alves³, B. McNab³, A. Rehmtulla³, S. McEwen⁴. ¹Animal Health Laboratory, University of Guelph, Guelph, Ontario, N1H 6R8, ²Health of Animals Laboratory, Health Canada, Guelph, ³Ontario Ministry of Agriculture, Food and Rural Affairs, ⁴Department of Population Medicine, University of Guelph.
There is increasing concern about the emergence and pattern of antimicrobial resistance among bacteria isolated from foods of animal origin. A collaborative research project between the Animal Health Laboratory, Health Canada, OMAFRA and the Dept. Population Medicine (OVC), to examine patterns of antimicrobial resistance in food-producing animals will be completed in May 2000.

This study will document patterns of bacterial resistance to antimicrobials commonly used in veterinary and human medicine among approximately 500 isolates from food animal veterinary cases submitted to the Animal Health Laboratory, University of Guelph. Similarly, antimicrobial resistance profiles of over 300 isolates obtained from fecal samples of healthy broiler chickens, market hogs, and beef collected at provincially inspected abattoirs from across Ontario will be documented. Antimicrobials will be consistent with those used in the National Antimicrobial Resistance Monitoring System (NARMS) of the United States. Antimicrobial sensitivity testing will be in accordance with NCCLS guidelines.

Preliminary results were presented in a poster session in Toronto at the 'Agriculture's Role in Managing Antimicrobial Resistance Conference', held October 24-26, 1999:

- Antimicrobial resistance appears to be less frequent amongst isolates from abattoir specimens than from clinical cases;
- Most Salmonella sp. and E. coli isolated from clinical specimens are resistant to at least one antimicrobial and many are multiply resistant;
- Salmonella typhimurium DT104 was the most frequent of antimicrobial resistant Salmonella sp. isolated.

Antimicrobial resistance is an issue for those that produce, process and sell food, consumers and government agencies. Resistance monitoring of the microflora of healthy and diseased animals is critical to making informed decisions about factors affecting consumer's health and determining the effective use of human and animal health drugs.

Testing bacterial isolates from abattoir and clinical specimens will provide useful baseline information on the frequency and occurrence of antimicrobial resistant bacteria that could potentially reach the consumer. This is one step in the process to determine the risks associated with antimicrobial use in food-producing animals. These surveillance data could be used to evaluate the risks associated with the use of antimicrobials in livestock. This research may form the basis of one component of ongoing surveillance of antimicrobial resistance in agriculture.

The above project is funded by the Enhanced Food Quality and Safety Research Fund, Ontario Ministry of Agriculture, Food and Rural Affairs.

5.7 Salmonella sp. surveillance

The graph below is a time series of isolates of Salmonella sp. from clinical samples submitted to the Animal Health Laboratory, University of Guelph. Characterization of these isolates is conducted at the reference laboratory of Health Canada. Private veterinarians work with their livestock clients to resolve these infections on-farm, often in collaboration with veterinarians at Veterinary Science -OMAFRA and at the Animal Health Laboratory - U of G. The trend in the frequency of Salmonella sp. data is being followed closely, including the occurrence of any widely multiresistant clones of strains such as S. typhimurium DT104. This strain currently accounts for 26-33% of all Salmonella sp isolates. Extension education messages about farm biosecurity, sanitation, the public health risk to those in direct contact with infected animals have appeared in animal health
5.8 Improvements in food inspection

Food Inspection - OMAFRA gets a new computer system

The **Food Safety Decision Support System** (FSDSS) is a new computer system for Ontario's food inspection programs. It supports food safety decision-making by managing information on day-to-day inspection activities and compliance assessment and tracking, providing electronic networking to laboratories and helps give expert assistance to inspectors in high-risk situations. The new system supports the business functions such as licensing activities; human resource and financial functions; information collection, analysis and reporting; and performance tracking and reporting. This Oracle-based system gives Food Inspection Branch the ability to respond immediately to food safety and animal health issues. The FSDSS is an important component of a new food safety system being developed for Ontario.

5.9 B.S.E. surveillance in Ontario

Bovine spongiform encephalopathy (BSE or "mad cow disease"), had a negative impact on the cattle and beef industries in the United Kingdom. Internationally, surveillance for BSE has become increasingly important to facilitate trade. To assist Canada in demonstrating active surveillance for BSE, the OAHSN contributes in the...
following manner. Appropriate tissue samples from bovine cases exhibiting nervous signs submitted to the AHL, as well as any animal with microscopic brain lesions, are forwarded to the national laboratory system according to the national BSE surveillance protocol of the Canadian Food Inspection Agency. Certificates from downer cattle are also monitored for unusual trends. This provides a traceback mechanism on these animals. All samples in this surveillance for BSE have been negative to date. The other provinces of Canada also submit samples as part of the national surveillance program. Provincial veterinarians from OMAFRA are working closely with officials from the federal government on BSE surveillance.

5.10 On-farm investigation of verotoxigenic E. coli in well water

This investigation was an example of collaborative investigative work between OMAFRA, Ontario Ministry of Health and Long Term Care, and Health Canada. A young child on a dairy farm was ill with a prolonged episode of severe diarrhea. The provincial public health laboratory confirmed the isolation of *E. coli* O157:H7. The private veterinarian involved with the dairy farm suspected the farm environment and alerted Veterinary Science - OMAFRA. *E. coli* O157:H7 was isolated from 63% of cattle on the farm through testing by Health Canada. Well water samples were also positive after special culture techniques were used by Ministry of Health and Long Term Care. Isolates from the water, the cattle and the child were Phage Type 14 and were virtually identical by pulsed - field gel electrophoresis. This collaborative work illustrated the potential risk of dairy farm well water as a potential source of *E. coli* O157:H7. Routine screening tests for *E. coli* in well water may not detect this vertoxigenic pathogen. An OMAFRA hydrogeologist conducted an on-farm audit of the well and the farm manure management. Recommendations were made regarding proper decommissioning of old wells, improvement to the main well head and farm drainage. For further details consult the reference below.


5.11 Sentinel herd milk quality project

The University of Guelph (OVC), Dairy Farmers of Ontario (DFO), the Ontario Association of Bovine Practitioners (OABP), Ontario Dairy Herd Improvement (ODHI) and OMAFRA, collaborated in a three year research project that has established a system of sentinel dairy herds, through selected veterinary practices in Ontario. Although the primary focus of the study is mastitis and milk quality, the study also provides spin-off value to OAHSN, by establishing direct surveillance links to 30 livestock veterinary practices in Ontario. These data are currently being analysed to examine factors affecting patterns of clinical mastitis over time, the accuracy of bulk tank cultures for predicting serious herd mastitis problems and the relationship between heifers and clinical mastitis.

The graph below indicates a marked seasonal pattern to the incidence of clinical mastitis cases in the sentinel herds. Using somatic cell counts, and other cow and herd factors this study hopes to better predict and prevent mastitis in dairy herds.
5.12 Post-weaning multisystemic wasting syndrome of swine

In late March of 1997, coordinators of CAHnet (the Canadian animal health network) sponsored a national telephone conference-call about a condition described as a "post-weaning multi-systemic wasting syndrome" (PMWS) in swine. A definitive cause of the syndrome has not yet been established, although a strain of porcine circovirus is suspected as a risk factor. Participants on the conference-call agreed that veterinarians and producers should be on the "look-out" for this syndrome and that more data were needed to further define the syndrome and its relative importance.

Subsequent to the conference call, members of the core group of OAHSN responded in the following manner: i) in cooperation with veterinarians from western Canada, a PMWS information sheet and case definition were written and circulated to Animal Health Laboratories in Ontario; ii) a presentation on PMWS was made at a meeting of the Ontario Swine Practitioners Association, to alert veterinary practitioners of the potential syndrome and to advise them on laboratory sample submission protocols; iii) an article and information sheet was distributed to essentially all swine producers and advisors in Ontario via the OMAFRA publication "Pork News and Views" (May'97 issue, circulation > 6000); iv) histopathology slides from cases in western Canada were distributed to Animal Health Laboratories in Ontario; v) provincial funding authorities were made aware of the need for a case-control study in Ontario, if case numbers warrant such a study; and vi) inspectors at provincially inspected abattoirs were alerted to look for signs of PMWS and encouraged to submit additional samples especially in BBQ weight slaughter pigs. Follow-up research was conducted by Population Medicine at the University of Guelph.
Future Plans

Future plans for OAHSN core group include:

1. Further refinement of the Ontario Animal Health Surveillance Network (eg. developing information sharing agreements with CAHnet - the national animal disease surveillance body; examining sentinel veterinary practice systems);
2. Further development of an early warning system of animal disease trends in Ontario and improve follow-up actions (eg. regular reporting of animal diseases important for trade, domestic health or public health; securing ongoing resources for outbreak investigation), and
3. Linking of information influencing animal health, food safety and public health (eg. collaborative outbreak investigation involving important zoonotic pathogens; summary of antimicrobial resistance surveillance data; pilot participation of the Animal Health Laboratory (U of G)in the Canadian Public Health Information System).

Overall Conclusions & Invitation For Comment

The previous sections illustrate Ontario's extensive animal health surveillance network and its ability to detect incursions of serious animal diseases and to rapidly communicate pertinent information to appropriate authorities and organizations. In partnership with such organizations, the OAHSN core group also facilitates or directly participates in appropriate follow-up actions in a timely and relevant manner. This helps to identify and manage risks to animal health in Ontario, and beyond. This should encourage confidence among the public in Ontario livestock and animal products, including foods of animal origin.

This is the second publication of this document describing the Ontario Animal Health Surveillance Network. It is by no means perfect, but the authors believe it to be a step in the right direction. You are invited to use this document to help explain the role, capability and concept of animal health surveillance in Ontario and to submit constructive comments to help improve future editions of this document. Please see appendix II for a list of core members of the OAHSN. Thank you.
### Appendix I

**List of Reportable Animal Diseases In Canada**

<table>
<thead>
<tr>
<th>Disease</th>
<th>OIE status</th>
</tr>
</thead>
<tbody>
<tr>
<td>African Swine Fever</td>
<td>A</td>
</tr>
<tr>
<td>Anaplasmosis</td>
<td>B</td>
</tr>
<tr>
<td>Anthrax</td>
<td>B</td>
</tr>
<tr>
<td>Aujeszky's Disease (pseudorabies)</td>
<td>B</td>
</tr>
<tr>
<td>Avian Influenza (fowl plague)</td>
<td>A</td>
</tr>
<tr>
<td>Bluetongue</td>
<td>A</td>
</tr>
<tr>
<td>Bovine Cysticercosis</td>
<td>B</td>
</tr>
<tr>
<td>Bovine Spongiform Encephalopathy</td>
<td>B</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>B</td>
</tr>
<tr>
<td>Contagious Equine Metritis</td>
<td>B</td>
</tr>
<tr>
<td>Dourine</td>
<td>B</td>
</tr>
<tr>
<td>Equine Infectious Anemia</td>
<td>B</td>
</tr>
<tr>
<td>Equine Piroplasmosis’</td>
<td>B</td>
</tr>
<tr>
<td>Foot-and-Mouth Disease</td>
<td>A</td>
</tr>
<tr>
<td>Fowl Typhoid</td>
<td>B</td>
</tr>
<tr>
<td>Glanders</td>
<td>B</td>
</tr>
<tr>
<td>Hog Cholera (classical swine fever)</td>
<td>A</td>
</tr>
<tr>
<td>Mange</td>
<td>not classified</td>
</tr>
<tr>
<td>Newcastle Disease</td>
<td>A</td>
</tr>
<tr>
<td>Pullorum Disease</td>
<td>B</td>
</tr>
<tr>
<td>Rabies</td>
<td>B</td>
</tr>
<tr>
<td>Rinderpest</td>
<td>A</td>
</tr>
<tr>
<td>Scrapie</td>
<td>B</td>
</tr>
<tr>
<td>Sheep scab</td>
<td>not classified</td>
</tr>
<tr>
<td>Swine Vesicular Disease</td>
<td>A</td>
</tr>
<tr>
<td>Swine Vesicular Exanthema</td>
<td>not classified</td>
</tr>
<tr>
<td>Trichinosis</td>
<td>B</td>
</tr>
<tr>
<td>Tuberculosis (M. bovis &amp; M. tuberculosis)</td>
<td>B</td>
</tr>
<tr>
<td>Varroasis (mites in bees)</td>
<td>B</td>
</tr>
<tr>
<td>Vesicular Stomatitis</td>
<td>A</td>
</tr>
</tbody>
</table>
## Appendix II

### Core Members of the OAHSN

<table>
<thead>
<tr>
<th>Name &amp; Affiliation</th>
<th>Training / Specialty</th>
<th>Contact Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. David Alves, Provincial Veterinarian Veterinary Science, OMAFRA 3 SE, 1 Stone Road W Guelph, ON N1G 4Y2</td>
<td>DVM PhD epidemiology, surveillance, field investigation and technology transfer</td>
<td>phn: (519) 826-3127 fax: (519) 826-3254 <a href="mailto:david.alves@omafra.gov.on.ca">david.alves@omafra.gov.on.ca</a></td>
</tr>
<tr>
<td>Dr. Paul Innes Veterinary Science, OMAFRA, RR#1 Fergus, ON Canada, N1M 2W3.</td>
<td>DVM MSc epidemiology, surveillance</td>
<td>phn: (519) 846-3407 fax: (519) 846-8101 <a href="mailto:paul.innes@omafra.gov.on.ca">paul.innes@omafra.gov.on.ca</a></td>
</tr>
<tr>
<td>Dr. Beverly McEwen, Animal Health Laboratory, Laboratory Services Division, University of Guelph, Guelph, ON, Canada, N1H 6R8.</td>
<td>DVM MSc PhD Diploma ACVP veterinary pathology</td>
<td>phn: (519) 824-4120 x4537 fax: (519) 821-8072 <a href="mailto:bmcewen@lsd.uoguelph.ca">bmcewen@lsd.uoguelph.ca</a></td>
</tr>
<tr>
<td>Dr. Tom Baker, Food Industry Division, OMAFRA, 1 Stone Road W, Guelph, ON, Canada N1G 4Y2.</td>
<td>DVM MSc epidemiology and meat inspection</td>
<td>phn: (519) 826-4366 fax: (519) 826-4375 <a href="mailto:tom.baker@omafra.gov.on.ca">tom.baker@omafra.gov.on.ca</a></td>
</tr>
<tr>
<td>Dr. Bruce McNab, Research &amp; Corporate Services Division, OMAFRA, 1 Stone Road W., Guelph, ON, Canada N1G 4Y2.</td>
<td>DVM PhD epidemiology and risk assessment</td>
<td>phn: (519) 826-4178 fax: (519) 826-4211 bruce.mc <a href="mailto:nab@omafra.gov.on.ca">nab@omafra.gov.on.ca</a></td>
</tr>
</tbody>
</table>
### Appendix III

**OAHSN Annual Summary Statistics 1997 - 98**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Dairy</th>
<th>Beef</th>
<th>Swine</th>
<th>Poultry</th>
<th>Sheep &amp; Goats</th>
<th>Horses</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of farms</td>
<td>7,503</td>
<td>14,172</td>
<td>7,000</td>
<td>1,700</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>number of animals</td>
<td>630,000</td>
<td>1,628,000</td>
<td>3,308,000</td>
<td>37,337,700</td>
<td>260,000</td>
<td>293,000</td>
</tr>
<tr>
<td>inspected at abbatoirs/yr</td>
<td>102,655</td>
<td>715,505</td>
<td>3,509,657</td>
<td>187,940,050</td>
<td>189,587</td>
<td>5,433</td>
</tr>
<tr>
<td>at sales yards/yr</td>
<td>218,349</td>
<td>699,828</td>
<td>175,204</td>
<td>ND</td>
<td>148,615</td>
<td>7,362</td>
</tr>
<tr>
<td>specimens to AHL/yr</td>
<td>78,400</td>
<td>15,000</td>
<td>36,134</td>
<td>230,050</td>
<td>10,578</td>
<td>8,964</td>
</tr>
<tr>
<td>submissions to AHL/yr</td>
<td>5,750</td>
<td>1,150</td>
<td>1,689</td>
<td>4,936</td>
<td>591</td>
<td>1,723</td>
</tr>
<tr>
<td>necropsy cases AHL/yr</td>
<td>575</td>
<td>350</td>
<td>696</td>
<td>648</td>
<td>243</td>
<td>199</td>
</tr>
</tbody>
</table>

### OAHSN Annual Summary Statistics 1998 - 99

<table>
<thead>
<tr>
<th>Subject</th>
<th>Cattle</th>
<th>Swine</th>
<th>Poultry</th>
<th>Small ruminants</th>
<th>Equine</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of farms (1996 census)</td>
<td>21,675</td>
<td>7,000</td>
<td>1,700</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>number of animals (inventory 1/99)</td>
<td>2,053,000</td>
<td>3,440,800</td>
<td>35,597,000</td>
<td>200,000 (est)</td>
<td>293,000</td>
</tr>
<tr>
<td>abattoir inspections (1998 total)</td>
<td>747,512</td>
<td>3,322,572</td>
<td>217,327,924</td>
<td>193,252</td>
<td>64,402</td>
</tr>
<tr>
<td>saleyard inspections (1998 total)</td>
<td>888,581</td>
<td>175,792</td>
<td>ND</td>
<td>165,942</td>
<td>6,652</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>----</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>AHL cases - total (5/98-4/99)</td>
<td>8,295</td>
<td>2,854</td>
<td>5,276</td>
<td>777</td>
<td>4,849</td>
</tr>
<tr>
<td>AHL pathology cases (5/98-4/99)</td>
<td>1,424</td>
<td>1,228</td>
<td>849</td>
<td>439</td>
<td>520</td>
</tr>
</tbody>
</table>

ND = no data available
Ontario Animal Health Surveillance Network

External Links

Proceeding beyond this point constitutes an acknowledgement that the user has read the contents on the Disclaimer and agrees to the terms and conditions set therein.

Web sites for organizations mentioned in the OAHSN document:

- College of Veterinarians of Ontario (CVO) - www.cvo.org
- University of Guelph - www.uoguelph.ca
- Animal Health Laboratory - www.uoguelph.ca/labserv
- CFIA - www.cfia-acia.agr.ca
- Health Canada - www.hc-sc.gc.ca
- Agriculture Canada - www.agr.ca
- Dairy Farmers of Ontario - www.milk.org
- Ontario Dairy Herd Improvement Corporation - www.ontdhi.com
- Ontario Cattlemen's Association - www.cattle.guelph.on.ca
- Ontario Pork - www.ontriopork.on.ca
- Canadian Animal Health Network - www.cahnet.org
- Association of Public Health Epidemiologists in Ontario - www.cehip.org/apheo