The Scientific and Regulatory Basis
Of Meat Inspection In Ontario

Meat Inspection Review, Expert Advisory Panel
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Submitted to: Justice Roland J. Haines, Review of the Meat Inspection and Regulatory Regimes in Ontario
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EXECUTIVE SUMMARY

In January 2004, the Honourable Roland J. Haines was appointed to "…review, on a systemic basis, the meat regulatory and inspection regimes, including free standing meat processors, in Ontario in order to strengthen public health and safety and business confidence." As part of his review, Justice Haines assembled an Expert Advisory Panel from academia, industry and private consulting to provide him with information and analysis concerning the scientific and regulatory basis of meat inspection in Ontario. The Panel was asked to use their collective knowledge and experience to identify the key scientific and regulatory issues, to make recommendations, and to prepare a report in a form to be read by a layperson, rather than a peer-reviewed scientific paper. The Panel consulted with several other experts from Canada and the United States who critiqued an early draft of the Panel’s report and provided additional perspective at a one-day workshop held on March 25, 2004. Subsequently, the Panel undertook further drafting and then presented its final report to Justice Haines on May 14, 2004.

Ontario is not alone in taking a close look at elements of its food safety system. Around the world, public confidence in the safety of the food supply has been shaken many times in recent years. *Escherichia coli* O157:H7 in hamburgers and water, dioxins in farmed salmon, BSE in cattle, *Salmonella* in eggs, and the safety of genetically modified foods are just some of the high profile problems or issues that have challenged food safety systems in recent years. A critical review of meat inspection in Ontario requires an understanding and analysis of its scientific and regulatory basis. With this in mind, the objectives of this report are to: 1) describe the impact of foodborne illness in Ontario; 2) describe meat inspection regulation, practices and procedures in Ontario; and 3) analyse the capabilities and limitations of meat inspection in Ontario. The following is a brief summary of the major themes, conclusions and recommendations of the report.

I. MEAT SAFETY FROM FARM-TO-FORK

The food continuum within Canada consists of four sectors; the primary production sector, the processing sector, which includes harvesting and putting raw materials in a form the consumer can use, the distribution/retail/food service sector, and the consumer sector. Pathogens and chemicals can contaminate at any point along the food chain, including but not limited to, the farm, the slaughterhouse, processing plant, transportation vehicle, retail store or foodservice operation, and the home. All sectors of the food industry have a responsibility and interest in ensuring safe food. Hazard Analysis and Critical Control Point (HACCP) programs are now being used in various sectors of the food industry. The HACCP approach focuses on prevention and control and is advocated for every stage in the food chain, from primary producers up to the final consumer.

An ideal food safety system has an infrastructure to trace the origins and destinations of whole and processed food and their inputs. Open and transparent traceability of a food product can strengthen the management of food safety along the farm-to-fork continuum. There are some success stories in traceability of meat in Ontario, but there are improvements to be made.

Although not food for humans, dead animals and waste products from animal production are issues for food safety, public health, animal health, and the environment. Dead animals are a normal by-product of farming because animals sometimes die from disease, accidents, or other causes. In the past,
dead stock collection services have generally been available to service farmers at no cost because the returns from the sale of dead stock by-products, i.e. hides, rendered products and meat for pet food, covered the cost of removal. However, markets started to fall in 1997. Cow hides currently sell for less than half of the 1996 price, and there is a significantly reduced market for rendered products. Furthermore, the May 2003 discovery of BSE in western Canada and its after-affects, including closure of the U.S. border to trade in many animal-derived products, and an anticipated voluntary ban on use of animal-derived protein in pig feeds in Ontario, have precipitated a crisis in dead stock and rendering industries. There is need for short and longer term solutions to the dead stock problem, including better provisions for on-farm and centralized disposal (e.g. composting) and more opportunities for profitable recycling in ways that protect human and animal health and the environment.

II. OVERVIEW OF MEAT PRODUCTION, PROCESSING, AND DISTRIBUTION IN ONTARIO

The meat industries in Ontario are diverse and complex. Among the major species (e.g. cattle, swine, chickens), most of the animals are raised on larger farms that specialize in single species. Improvements in infectious disease control and better management and nutrition in animal production have facilitated these changes, but economic forces also play a role. There are also many smaller farms that raise one or more species of animal, bird or fish for food and many sell in local or niche markets.

Small numbers of animals are killed and dressed by citizens for their own use, but all meat for legal sale to the public must be slaughtered in a licensed establishment and inspected and approved by either federal (CFIA) or provincial authorities. In Ontario in 1999 there were 33 federally inspected and 229 provincially inspected slaughter facilities. Provincialy inspected slaughter facilities (also known as abattoirs, slaughterhouses) are located throughout the province. Some are “custom kill” operations that slaughter and perform basic butchering services for individual customers, while others carry out further processing (e.g. sausage, smoked meats) for sale to the public on premises or through other retail or foodservice outlets. Free standing meat processors in Ontario are manufacturing facilities that are not provincially licensed abattoirs nor federally registered establishments (both of which slaughter animals). They are included under the definition if they can be categorized as undertaking either of the following activities:

- cutting, boning, breaking, comminution (e.g. grinding, flaking, etc.), fabrication, cooking and repackaging of meat products; in addition, they distribute some portion of their products through any wholesale or retail outlet not connected to the processing plant; or

- by-product dressing for human consumption, (e.g. offal processing or singeing of beef feet/ skin), curing, fermenting, canning of meat products or vacuum packaging of high-risk meat products.

In 2002, there were an estimated 681 free standing meat processors in Ontario.
III. PUBLIC HEALTH HAZARDS IN MEAT AND TRENDS IN FOODBORNE ILLNESS IN ONTARIO

The infectious agents of concern to food safety are microbes capable of infecting people and causing illness. These agents include bacteria and their toxins, viruses, parasites and prions (which have some, but not all characteristics of infectious agents). Some of these agents occur naturally in the environment (e.g. water, soil), and others are normally resident in animals or humans. The non-infectious agents of importance to food safety include toxic chemical compounds or elements, and physical hazards, such as metal objects, glass or other physical materials. Microbial agents are responsible for by far the greatest proportion of reported foodborne illnesses in Ontario and other developed regions. Some of these agents, especially the zoonotic infections derived from animals (e.g. *E. coli* O157:H7, *Salmonella*, *Campylobacter*) can contaminate fresh meat at slaughter and are public health problems if meat is improperly cooked or handled. Other agents are mainly of environmental or human origin and are especially important when they contaminate meats after processing (e.g. *Listeria*, *Shigella*).

In 1997-2001 there were 44,451 reported sporadic cases of eight enteric illnesses in Ontario. Food was considered the source of infection in 74% of cases, but a specific food type was named in only 21% of these cases.

IV. FOOD SAFETY LABORATORY SUPPORT AND FOODBORNE DISEASE SURVEILLANCE

Laboratory and surveillance support is critical for the proper functioning of a modern meat inspection system. In recent years, there has been an exponential growth in the demand for testing to support a growing number of foodborne monitoring and quality assurance programs as a result of increased public awareness, globalization, emergence of new pathogens, and terrorism. In addition, we have seen an unparalleled technological evolution, which has increased the ability to detect chemical and microbiological contaminants to new levels.

Laboratory support for meat inspection programs is provided by veterinary diagnostic laboratories, the Canadian Food Inspection Agency (CFIA), Ontario Public Health and Food Laboratories, and in some cases, industry quality assurance laboratories. A wide variety of samples are submitted to these laboratories, including specimens from animals on-farm or at-slaughter, food, water and environmental samples from processing establishments, food and other samples from retail outlets, foodborne disease outbreak investigations, and special surveys. Furthermore, there are a number of food hazard surveillance programs conducted by the Ontario Ministry of Agriculture and Food (OMAF), including baseline studies of microbial and chemical hazards in meat.

Within the OMAF meat inspection program, laboratory samples are submitted using electronic forms as part of The Food Safety Decision-Support System. When appropriate staff approve results, they are reported electronically and can be accessed in a real-time manner. Within the public health system, inspectors from Health Units submit food samples with paper forms to laboratories. At present, in the Public Health Laboratories, there is no electronic system to send results of food samples to the public health inspector. If the laboratory finds bacteria that cause food poisoning at significant levels the Health
Unit is contacted by phone. Furthermore, all Ontario Health Units utilize the Reportable Disease Information System (RDIS) for tracking reportable communicable diseases. This provincial surveillance system was developed in the 1980’s and is based upon a proprietary architecture that is no longer widely used or supported. Because of the serious deficiencies in this outdated system, all time-critical surveillance reports of communicable diseases are provided to the Ministry of Health and Long-Term Care through telephone calls, emails, letters, faxes, etc.

There are also a number of federal-provincial surveillance initiatives intended to enable public health professionals from across Canada to have quick and efficient access to enteric outbreak information in the interest of public health protection and response. These include web-based and other electronic applications, including the Public Health Information System, and a molecular epidemiology tool (PulseNet), which has been extremely useful on a number of occasions to rapidly detect the source of an outbreak and to aid in control measures.

Despite these efforts there remains a critical lack of real-time electronic linkages and analysis between these food safety surveillance systems. Linkages between food safety surveillance systems at the private, municipal, provincial and federal levels remain antiquated, under funded and unable to cross-communicate in a real-time fashion.

V. MEAT INSPECTION SYSTEMS IN ONTARIO

Meat inspection (also known as meat hygiene) is the general term for inspection of livestock slaughtered for food. Its principal goals are provision of safe and wholesome meat products for consumers, and contribution to animal health surveillance and humane animal handling. Provincial inspection during the slaughter of animals is required for sale of meat not covered by federal inspection, and is administered by the Ontario Ministry of Agriculture and Food. The Meat Inspection Act and Regulations (Ontario) provide the regulatory basis for inspection in provincially inspected abattoirs and address a variety of species, including beef, pork, veal, poultry, rabbit, sheep, lamb, goat, ratite (emus and ostriches) and domestic wild game.

Slaughter facilities must be licensed and are subject to a number of requirements for construction and equipment. The province provides the meat inspection services to the 194 provincial abattoirs. In 2002-2003 there were 133 meat inspectors (10 full time and 131 contract) in Ontario who delivered approximately 195 thousand hours of inspection. Inspectors’ duties cover the range of activities, but most of their time is devoted to ante-mortem (before slaughter) and post-mortem (after slaughter) inspection of every animal. These inspectors are supported by 4.5 ministry veterinarians. One hundred and thirty appointed veterinarians (private practitioners) are on call for the inspection and disease diagnosis regarding living, compromised animals (i.e. veterinary ante-mortem inspection) and/or inspection and diagnosis regarding suspect carcasses and their accompanying organs (veterinary post-mortem inspection).

Animals and carcasses may be condemned in whole or in part as unfit for human consumption based on the findings from ante- and post-mortem inspection. The general criteria include the presence of localized or generalized disease, the nature of the disease or condition present, and consideration of the
public health significance of the condition. Most diseases and conditions detected in Ontario animals are not of public health significance, but are removed because they are repugnant to consumers.

Responsibility for inspection of restaurants is that of Public Health Units. The authority for inspection is provided in the Health Protection and Promotion Act (HPPA) and its accompanying guidelines, protocols and regulations. The Food Safety Program Standards require that a risk assessment be undertaken for all food premises within the jurisdiction of each Board of Health and based upon this assessment each food premise is to be designated either high, medium or low risk, which determines the frequency and type of inspection. The Food Handler Training protocol specifies that an employee with a valid food safety training certificate must be present at all times in high and medium risk food premises which have three or more employees, although this has not been enforced because the protocol does not have the force of law.

Food-borne outbreaks frequently cross agency, ministry, provincial, federal and territorial mandates. The Ontario Inter-Agency Council on Food Safety is an important vehicle for ensuring inter-agency communication and providing a forum to resolve issues related to Ontario’s food safety system. This includes outbreak or emergency response.

VI. THE ROLE OF SCIENCE IN MEAT INSPECTION SYSTEMS

In a science-based meat inspection system the available scientific information and technology are used to identify and characterize food safety risks, and the options for reducing these risks. Model food safety systems are science-based, with a strong emphasis on risk analysis, to allow regulators, industry and other stakeholders to set priorities for resources based on existing data. Food safety risk management activities should address the risks deemed to have the greatest potential impact.

Risk analysis provides a science-based approach to address food safety issues. Risk analysis comprises risk assessment, risk management and risk communication. Risk assessment seeks to describe the probability and impact of adverse health effects. Risk management is typically the function of individuals or organizations entrusted with formulating and executing laws and regulations designed to protect public health, and organizations responsible for design and implementation of risk reduction programs (e.g., meat inspection). Risk communication is the process of ensuring that parties with a stake in the outcomes of risk analysis have an opportunity to become informed and provide input and critical review. Science also has important roles in establishing food safety standards for meat (e.g., criteria for chemical and microbial hazards in meat) and in providing the basis for HACCP and other food safety programs.

Integrating science into meat inspection and related regulatory programs requires adequate human resources and technical capacity. Trained scientists currently support food safety efforts within several Ontario ministries and public health units, and provide expertise that spans the farm-to-fork continuum. Experts in food animal production, meat inspection, slaughter and meat processing are concentrated in the Ontario Ministry of Agriculture and Food. Foodborne disease surveillance and diagnostic experts are located within the Ontario Ministry of Health and Long-Term Care. Several public health units have additional scientific support in foodborne disease epidemiology.
VII. **BSE AND *E. coli* O157:H7 - ROLES AND CAPABILITIES OF MEAT INSPECTION REGIMES IN ONTARIO**

Bovine Spongiform Encephalopathy and *E. coli* O157:H7, were used as examples for a more focussed, integrated, and hazard-specific examination of the capabilities of meat inspection regimes in Ontario. Bovine Spongiform Encephalopathy is a fatal brain disease of cattle that is one of a group of diseases of animals and humans called transmissible spongiform encephalopathies (TSEs). The principal means of transmission to cattle is the feeding of ruminant-derived protein supplements (meat and bone meal) containing the BSE agent. Experimental studies have shown that certain tissues of cattle with BSE may contain infective material. These are called Specified Risk Materials (SRM) and by international consensus include the skull, brain, trigeminal ganglia, eyes, tonsils, spinal cord and dorsal root ganglia of cattle over 30 months of age (OTM), and the distal ileum of cattle of all ages. Removal of SRM at slaughter is an important food safety measure in countries with BSE in cattle. Creutzfeldt-Jakob disease (CJD) is a human TSE. It is rare and always fatal and occurs in classical and variant forms. The variant form (variant CJD) is linked to consumption of contaminated beef from cattle with BSE.

Ontario makes a substantial and appropriate contribution to BSE control in Canada. Important public sector functions include inspection at slaughter, surveillance, active participation in federal programs and surveillance, and extension. Many of these functions are collaborative in nature and carried out with federal and private sector partners, and so far as we can tell, it appears that there is good cooperation and communication among these partners. Within the scope of provincial responsibility, the most critical activities include the provision of effective ante-mortem and post-mortem inspection, effective SRM removal from carcasses at provincially inspected abattoirs, and surveillance.

For many Canadians, the May 2000 waterborne outbreak in the town of Walkerton highlighted the public health threat posed by *E. coli* O157:H7, but it is also an important foodborne disease in Ontario. Control of this pathogen truly involves the farm-to-fork spectrum, and virtually all agencies and stakeholders involved in provision of safe meat and meat products have roles to play.

Controls for *E. coli* O157:H7 in abattoirs and meat processing facilities include proper sanitation of facilities, equipment, and food contact surfaces, proper use of sanitizers, proper techniques for carcass dressing (e.g. hide and viscera removal), proper use of hand washing, and sanitizing of knives. Examples of interventions for removal of microbial contamination include requirements and conditions for trimming of visible fecal contamination, and use of steam and hot water treatments (e.g. carcass “pasteurization” to kill surface contaminants), spray rinses (with or without added chemicals such as organic acids) and rapid chilling.

Epidemiological studies have clearly shown the importance of safe food handling and other interventions at retail, food service and the home for the effective control of *E. coli* O157:H7. Industry, public health inspectors, and consumers must share control efforts. Evidence suggests that these are best achieved through HACCP-based food safety programs that provide for general sanitation and hygiene as well as specific interventions, food handler training, and regular inspection with verification. In Ontario there are important capabilities from production through consumption that include both public and private sector activities, as well as consumer responsibilities. Current gaps include lack of universal HACCP-based food safety and tracking systems that pertain to *E. coli* O157:H7 and problems with disease
reporting capabilities. While important elements of a comprehensive set of controls exist in Ontario, in some cases these appear to function more-or-less in isolation. Therefore greater coordination among those responsible is needed for effective control of this important pathogen, which causes hundreds of cases of illness in Ontario every year.

VIII. LOOKING AHEAD

For a jurisdiction like the Province of Ontario, what would a model science-based meat inspection regime look like? From a scientific perspective, what should be done to strengthen the existing system to have it more closely approximate the model legislative and regulatory regime? As to the first question, fortunately this Panel does not have to begin from scratch to develop a model regulatory inspection system; through a remarkable consensus building process over an eight-year period, a group of food safety regulators and meat inspection specialists from across Canada have succeeded in developing a model National Meat and Poultry Regulations and Code (NMPRC). As to the second question, we have reviewed this regulatory scheme, the proposed Food Safety and Quality Act, 2001 and its companion legislation, the Health Protection and Promotion Act, and we conclude that taken together this system, adequately resourced, with a few important improvements that are discussed below, would significantly strengthen the existing system and would give Ontario a strong and comprehensive meat inspection regime as good or better than any provincial system in Canada and roughly equivalent to the federal system which has been internationally recognized as equivalent to the best in the world.

The important improvements include recommendations concerning improved interagency coordination, deadstock, free standing meat processing plants, training and education, on-farm issues and traceability, and HACCP. These subjects are described in detail throughout the full report and the recommendations are provided in chapter 9.

IX. CONCLUSIONS

We have examined meat inspection in Ontario with regard to its scientific basis, regulatory structure and capabilities, and have identified a number of strengths and weaknesses. Overall, we conclude that Ontario’s current meat regulatory and inspection regimes are based on sound scientific principles, and are providing a reasonable level of public health and safety to the citizens of the Province. Nevertheless, diseases associated with food animals and their products remain important public health problems in the Province, and recent global trends suggest that new and perhaps more serious foodborne diseases are likely to emerge in the future. Furthermore, BSE and other food safety issues in Canada and abroad have raised public concerns and expectations concerning food safety to new levels, and these are having dramatic impacts on food animal production, processing, marketing and waste disposal. In order to keep abreast of these developments, to better address foodborne disease, and to ensure a comprehensive, science-based food safety system that is capable of managing the problems of tomorrow, the strengths of the current regimes must be maintained and the deficiencies that exist in certain areas must be addressed.

Our recommendations cover a broad range of issues but six over arching themes emerge:
1. Science capacity

Food safety systems must be firmly based on sound science for the efficient and effective management of food safety problems, protection of public health and maintenance of consumer and business confidence. These systems should adhere to good risk analysis principles, and should have adequate scientific expertise and laboratory capacity to support policy development and programs. The current inspection regimes are solidly based in risk analysis and have been aggressively and appropriately using research, baseline studies and risk assessments to support the meat inspection, HACCP and other programs that are intended to improve food safety. It is critical to maintain a high-quality food safety science capacity in Ontario that is based on solid research, surveillance and risk analysis.

2. Surveillance

Food safety surveillance is the timely collection, analysis and dissemination of foodborne disease and food hazard data. High-quality surveillance is critical in order to identify foodborne disease trends and emerging problems, identify and minimize the impact of outbreaks, prevent spread to larger populations, and to plan and evaluate food safety programs (e.g. HACCP, inspector and food handler training programs). In addition to surveillance of foodborne diseases, there is continued need for surveillance of hazards throughout the foodchain through ongoing monitoring, as well as periodic baseline or targeted studies. These data should support risk analysis and be used to develop food safety criteria. The current foodborne disease surveillance system is fragmented and relies on outdated methodologies. There is need for improved foodborne disease reporting, more resources for timely data analysis, interpretation and dissemination to those that need to know (e.g. enhanced computer systems, new technologies, more epidemiological expertise), and for better coordination among responsible officials at the provincial level, and among provincial and federal partners in foodborne disease control.

3. A Farm-to-Fork Approach

Meat inspection used to be limited to carcass-by-carcass evaluation of animals at slaughter and a “command and control” approach to regulation in slaughterhouses, instead of focussing on prevention. However, it is now known that foodborne contaminants cannot be “inspected out” at slaughter or any other single point in food production or processing, and that quality and safety must be built into the process of food production. Therefore, in this report we have taken a much broader view of meat inspection systems, and conclude that food safety controls are needed throughout the farm-to-fork continuum. But the responsibility lies not only with government; industry and the public also have important roles to play. Food safety programs based on the HACCP system and Good Production / Manufacturing Practices should be encouraged throughout the farm-to-fork continuum. These should be designed with specific public health objectives in mind, and be guided by surveillance and risk analysis.

4. Regulatory Flexibility

The remarkable success in controlling many foodborne diseases must be considered as one of the great achievements of public health in the 20th century. Food-safety regulatory agencies have almost eradicated human disease and deaths from bovine tuberculosis, brucellosis and botulism from commercial products, for example, but several more recent factors, such as increases in world food trade, new emerging pathogens, the role of food processing operations, and the aging population have combined to create major new challenges. Even if all of our recommendations are implemented and adequately
resourced, food-safety regulators will have to have the resources and ingenuity to adapt to changing circumstances and to constantly strive to stay current. Our report deals with a number of matters that were not even seen as issues two years ago and the pace of change will not diminish. The regulatory system must be flexible and responsive to cope with new challenges and scientific change.

5. Human Resources

A regulatory system can only be a good as the people implementing it. That means that the public servants at all levels of the meat inspection system need to be adequately resourced, well trained and have a clear understanding of their roles. To overcome some of the problems of the past and to meet the challenges of the future, managers of the meat inspection system at all levels will have to provide strong leadership in human resources management.

6. Working Together

Meat safety, like food safety more generally, is necessarily a shared responsibility all along the food chain from the producer to the consumer and across all levels of government. The current inspection regimes are active at these levels, but there is need for greater integration and coordination of government activities and programs. The meat inspection system must be a real system that provides for timely sharing of information to ensure comprehensive and coordinated emergency planning and response. Strong inter-agency coordination is a *sine qua non* for an effective Ontario meat inspection system.

We therefore respectfully submit the following summary of recommendations.

**Recommendations:**

1. **We recommend that** the Province of Ontario adopt regulations that are equivalent to the National Meat and Poultry Regulations and Code.

2. **We recommend that** the Food Safety and Quality Act be proclaimed without further delay.

3. **We recommend that** Ontario maintain a high quality food safety science capacity that is based on solid research, surveillance and risk analysis.

4. **We recommend that** the proposed amendments to the Food Premises Regulation be adopted but with a phase in time for mandatory food handler training/certification of no longer than two years for high risk and medium risk establishments.

5. **We recommend that** the Province of Ontario:

   i. Establish an **Ontario Food Safety Reporting Centre (OFSRC)**. This Centre would be responsible for coordination for all matters relating to food safety reporting in the Province. The OFSRC would report to the Chief Medical Officer of Health for the Province of Ontario. All Ministries in the Province that have responsibilities in food safety (OMAF, MOHLTC and MNR) would be required to report any data, issues and concerns to the OFSRC. The OFSRC would be equipped with the technology and resources to provide real-time reporting from multiple jurisdictions and analytical and GIS mapping capability. This Centre would provide early warning and coordination to ensure rapid investigation of threats and unusual occurrences in Ontario, risk communication with the public and provide linkages to Federal authorities.
ii. Create the new position of **Chief Veterinary Officer for Ontario** that would have responsibility for meat inspection and animal health within the province.

iii. Implement electronic submission and reporting forms for the food safety investigation samples submitted by Public Health Inspectors that would be comparable to the electronic system currently in place for the Meat Inspection Program of the Food Inspection Branch, OMAF.

iv. Implement the eLEXNET system (or a comparable system) in all food laboratories (Federal, Provincial, and Private) in Ontario. This type of system can extract and integrate data from differing reporting systems.

v. Carry out a review to determine whether the capacity of the current level 3 containment facilities is adequate to support investigations into emerging pathogens and other sources of foodborne illness and to fund the necessary enhancement.

vi. Expand its capacity to conduct testing and research on the causes of foodborne illnesses and on prion related zoonotic diseases such as bovine spongiform encephalopathy (BSE).

6. **We recommend that** the Chief Medical Officer of Health through the Ontario Food Safety Reporting Centre ensure the activation of the Ontario Outbreak Investigation Coordinating Committee (OOICC) for all appropriate food safety situations as designated under the Memorandum of Understanding for Foodborne Illness Outbreak and Hazard Response and Product Recalls, including appropriate food recall situations.

7. **We recommend that** the relevant recommendations of the Interim Report of the Ontario Expert Panel on SARS and Infectious Disease Control, including Recommendations 10, 36, 37, 38, 39, 40, 41 be implemented.

   For ease of reference those recommendations are as follows:

   (1) **Recommendation 10**

   “The Ministry should establish a process to develop regional infection control networks across Ontario with a designated hospital and public health unit as joint leads in the development process. The networks should include but not be limited to public health units, hospital infection control practitioners, emergency health services, long-term care, and community based health care providers.”

   (2) **Recommendation 36**

   “The Ministry should build on work undertaken to date and develop a comprehensive, provincial infectious disease surveillance plan by June 30, 2004. This work should:

   - be carried out by a multi-disciplinary group, which includes scientific, government, information technology and health care partners, and which is accountable to the Minister of Health and Long-Term Care.
   - involve aligning and clarifying the roles of post-SARS provincial advisory committees with working groups examining the issue of disease surveillance.”
• examine any opportunities or barriers to using existing tools such as Telehealth and Telemedicine.

• include province-wide surveillance for facility-acquired infections.”

(3) **Recommendation 37**

“The Ministry must ensure that an appropriate information technology infrastructure is in place to fully support the provincial infectious disease surveillance plan by June 30, 2004.”

(4) **Recommendation 38**

“The Ministry should expedite the full implementation of the Integrated Public Health Information System (iPHIS), together with any required design modifications, across all Public Health Units in the province by June 30, 2004.”

(5) **Recommendation 39**

“The Ministry must move rapidly to fully implement the necessary information technology supports to allow for contact tracing and quarantine management by Public Health Units by June 30, 2004. If this cannot be accomplished through design modifications to iPHIS, other suitable information technology platforms must be used.”

(6) **Recommendation 40**

“The Ministry should establish a working group with representation from healthcare stakeholders, researchers, and the Ministry to review on an urgent basis all data access and data sharing protocols between Public Health Units, the Ministry, municipalities, and the federal government. This review should identify how and to whom identifiable personal information is authorized to flow in the event of an outbreak. The working group should submit a report to the Minister by March 31, 2004 outlining the common data sharing structure, reporting relationships, and other common requirements of the data access and sharing protocols.”

(7) **Recommendation 41**

“The Ministry should undertake a detailed legislative review of the Freedom of Information and Protection of Privacy Act and the Municipal Freedom of Information and Protection of Privacy Act in the context of:

• the reporting requirements set out under the Health Protection and Promotion Act.

• identifying potential barriers to the sharing of information in appropriate and timely manner.

• ensuring appropriate protections for personal information.”

8. **We recommend that** the necessary regulatory changes be made to increase the capacity to handle dead stock efficiently and safely. These changes include licensure of on-farm incinerators, composting, central compost and incineration facilities, transfer stations and inclusion of “minor use” species.

9. **We recommend that** the province provide interim financial support to the dead stock industry (collectors, facilities operators) to see it through the present crisis and ensure collections and safe
disposal continue in the short term. The industry and the ministry should co-ordinate their planning and resourcing for longer term solutions involving alternative recycling.

10. **We recommend that** producers be allowed to transport their own dead stock to central disposal facilities using appropriate safeguards, and that dead stock can be held longer than 48 hours on farm with proper refrigeration and storage.

11. **We recommend that** dead stock be part of the food safety surveillance system in the province, and that operators keep records that enable traceback.

12. **We recommend that** the province undertake an in-depth study with significant accompanying resources to determine what environmentally sound disposal facilities are needed in Ontario. This would be followed by action to support the development and availability of the recommended processes.

13. **We recommend that** the establishment of a provincial licensing system be established for free standing meat processing plants.

14. **We recommend that** consistent with the provisions of the Ontario Food Safety and Quality Act and its regulations, the Ministry of Agriculture and Food assume responsibility for the inspection of free standing meat processing plants.

15. **We recommend that** where there is overlap in legislated responsibility between the Ontario Ministry of Agriculture and Food and the Ministry of Health and Long-Term Care for the inspection of free standing meat processing plants, a partnership agreement be established to avoid duplication.

16. **We recommend that** adequate staffing and training resources be allocated to ensure inspection standards for free standing meat processing plants are met.

17. **We recommend that** mandatory food handler training be implemented for all medium and high risk food premises consistent with the requirements of the Food Handler Training Protocol of the Food Safety Program of the Mandatory Health Programs and Services Guidelines of the Health Protection and Promotion Act as well as the medium and high risk facilities within the provincially licenced abattoirs.

18. **We recommend that** mandatory food handler training be phased in over a two-year period, with recertification every five years.

19. **We recommend that** the province develop a HACCP-based food safety system and provide HACCP training to all its inspectors and establishment operators following the same program where appropriate.

20. **We recommend that** existing food safety informational strategies be evaluated for effectiveness and that new informational campaigns be researched and developed to more effectively compel consumers to practice safe food handling and exercise safe food choices in the home.

21. **We recommend that** all sectors in the meat industry develop effective food safety traceability systems.
22. **We recommend that** all commodity groups develop programs for the transfer of relevant animal health and on-farm food safety information that would accompany animals sent from farm to slaughter.

23. **We recommend that** regulations concerning ante-mortem and post-mortem inspection, and SRM removal be strictly enforced, monitored, and be fully incorporated within HACCP-like food safety programs. Additional measures should be considered in the interests of public and business confidence concerning BSE risks from downers, with recognition of the implications of these additional measures.

24. **We recommend that** research be urgently carried out into the feasibility of regulated on-farm slaughter of non-ambulatory animals in Ontario.

25. **We recommend that** HACCP-based food safety programs should be implemented from production through slaughter and processing to the distribution, retail, and food service sector, through to the consumer sector. An overall framework should be built for the whole food continuum concurrent with the development of the producer and processor programs. The basic framework should be continuous, transparent, user friendly, and easily understood by all.

26. **We recommend that** the HACCP-based food safety program be completely integrated with the inspection program, and that there be cost-sharing by the industry and the Province, particularly in the areas of training and auditing.

27. **We recommend that** the HACCP-based programs should be mandatory for all licensed provincial meat plants, including all free standing meat processing plants. There would be a phase-in period of three to five years depending on the grace period during the initial implementation, which might last up to two years.
CHAPTER 1
INTRODUCTION

In January 2004, the Honourable Roland J. Haines was appointed to "...review, on a systemic basis, the meat regulatory and inspection regimes, including free standing meat processors, in Ontario in order to strengthen public health and safety and business confidence." (1) As part of his review, Justice Haines assembled an Expert Advisory Panel to provide him with information and analysis concerning the scientific basis of meat inspection in Ontario. The Panel was asked to use their collective knowledge and experience to identify the key scientific and regulatory issues, to make recommendations, and to prepare a report in a form to be read by a layperson, rather than a peer-reviewed scientific paper. Panel members, described in Appendix I, were selected from academia, industry and private consulting on the basis of their training, expertise and experience in meat inspection, food safety, and food regulation.

The Panel met five times in February and March 2004. After preparing a draft document, the Panel consulted with several other experts, also described in Appendix I, from Canada and the United States, who critiqued portions of the draft and provided additional perspective at a one-day workshop held on March 25, 2004. The Panel presented its final report to Justice Haines on May 14, 2004.

Ontario is not alone in taking a close look at elements of its food safety system. Around the world, public confidence in the safety of the food supply has been shaken many times in recent years. *Escherichia coli* O157:H7 in hamburgers and water, dioxins in farmed salmon, BSE in cattle, *Salmonella* in eggs, and the safety of genetically modified foods are just some of the high profile problems or issues that have challenged food safety systems in recent years. In the United Kingdom, repeated food safety crises contributed to substantial restructuring of food safety regulation, culminating in the formation of the Food Standards Agency (2). In the United States, food safety crises (e.g. the 1993 “Jack-in-the-Box” *E. coli* outbreak) and recognition of the serious public health impact of foodborne disease led to several reviews and analyses of food safety regulation, and calls for enhanced capacity (3,4). Here in Canada, the Canadian Food Inspection Agency (CFIA) was formed in 1997 in response to calls for greater efficiency and independence in regulation of food (5).

Meat inspection in Canada predates Confederation. Early meat inspection regimes sought to protect public health by preventing the sale of diseased or otherwise unwholesome meat, to improve standards of hygiene in slaughter and processing, and to protect the public from fraudulent or misleading practices and labelling. Laws and regulations were developed to protect all foods, not only meat; nevertheless, for a variety of reasons, meat has traditionally received special attention. Public health and consumer protection are still major objectives of meat inspection, however modern inspection systems seek broader goals, including greater access to trade in local, regional and international markets, enhanced consumer confidence, maintenance of animal health, and humane treatment of animals. The dramatic impacts on trade and consumer confidence from the recent discovery of BSE in western Canada and the United States clearly show the critical interrelationships that exist among food safety, public health, consumer perception, and the financial well-being of food-related industries and rural economies.

Ontarians enjoy an abundant, relatively cheap food supply. Food in Ontario is generally safe, but in common with the rest of Canada, the United States and other countries around the world, foodborne...
disease is an important public health problem. Every year, thousands of Ontarians fall ill from contaminated food products. Some cases are mild and self-limiting, while others are serious and life-threatening. A number of factors contribute to foodborne illness, including contaminated raw and processed products, improper food handler hygiene, improper or inadequate storage, and faulty food preparation. Meat and other foods derived from animals (e.g. milk, eggs) are important vehicles of foodborne infections of humans. In Canada and other developed countries, most foodborne infections are also zoonoses, which is the technical term for diseases that are naturally transmitted between other vertebrate animals and people. While some foodborne diseases originate in humans (e.g. Norovirus, Hepatitis A), and foods of plant origin are increasingly recognised as vehicles of human infection (e.g. *Salmonella* in sprouts, Hepatitis A in scallions, *Cyclospora* in raspberries), food animals are reservoirs of many important foodborne zoonotic infections, such as *E. coli*, *Salmonella*, and *Campylobacter*. When food animals carry these infections at the time of slaughter, meat may become contaminated, and unless destroyed, the organisms may cause human illness and sometimes death. Animals may also be indirect sources of food and waterborne infections, for example, *E. coli* O157:H7 in apple cider or lettuce, and *E. coli* and *Campylobacter* in water. In Canada, food contamination is thought to be the major source of human infection of many important zoonoses.

Most Ontarians live in urban or suburban centres and few slaughter animals themselves or produce much of their own food. Ontarians often have little understanding or knowledge of the origins of the meat they purchase and feed to their families. Many Ontarians purchase at least some foods that are locally produced and processed, however most food is purchased from shops and large supermarkets supplied with food from elsewhere in the province, across the country or around the world. Modern technology and trading practices facilitate an increasingly complex and centralized food production, processing and distribution system. Adding to this complexity, visitors and new immigrants may bring with them preferences for different meat products and processing methods.

These trends have important implications to food safety; some beneficial, and others not. Food safety hazards may enter the food chain at a number of points in the continuum from production to consumption (or “farm-to-fork”). In the case of microbial hazards, conditions of handling, storage and processing may have dramatic effects on pathogen survival, growth or toxin formation, greatly affecting their disease-causing potential at the time of consumption. While “meat inspection” was traditionally focussed at or near the point of slaughter, there is greater recognition that effective food safety programs need to control contamination throughout the food continuum. This is a considerable challenge, considering the number of industries and government ministries that have a stake in farming, inputs to farming (e.g. feed, veterinary care), meat packing and processing, food distribution and retail, food service, public health and medical care.

The natural, medical, veterinary and social sciences contribute substantially to effective and efficient food safety public policy, and scientific issues pervade meat inspection theory, regulation and practice. Microbiology, public health, toxicology, epidemiology, veterinary medicine, food science, food engineering, and statistics are just some of the science-based disciplines and fields that make important contributions to our understanding of the determinants of foodborne infections and intoxications, and provide the knowledge and tools for their prevention and control. The social sciences are also important for the insights they provide into human behaviours and values, and in measuring the effects of food safety on society. While science is a critical component of effective meat inspection systems, there are
limits to our understanding of foodborne hazards and how to control them efficiently and effectively in many situations.

A critical review of meat inspection in Ontario requires an understanding and analysis of its scientific basis. With this in mind, the objectives of this document are to: 1) describe the determinants and impact of foodborne illness in Ontario; 2) describe meat inspection regulation, practices and procedures in Ontario; and 3) analyse the capabilities and limitations of meat inspection in Ontario.

References and Bibliography

CHAPTER 2

MEAT SAFETY FROM FARM-TO-FORK

The meat production, processing, distribution, retail and foodservice industries are all part of a complex system that provides meat products for consumers. In the past, these industries have tended to approach food safety issues in an isolated manner. For some, there has been an unfortunate tendency to assume that government, or other industries, either up-stream or down-stream, should bear the major responsibility for implementing food safety controls. All too often, this has resulted in a fragmented approach to food safety. Later chapters describe in some detail the specific roles that government and industry can and should play in ensuring a ready supply of safe and nutritious meat products for consumers. However, the purpose of this chapter is to draw attention to the need for an integrated approach to safety throughout the farm-to-fork continuum, to touch on some of the international efforts in this area, and to highlight some of the not-so-obvious components in this continuum. An example of the latter is the rendering of waste products from meat production, which can have an indirect bearing on food safety, animal health and the environment.

I. INTERNATIONAL EFFORTS

Recent food safety crises within and beyond our borders have shown the deficiencies of some of the traditional approaches to food safety. Some of these crises, for example BSE in cattle, *Salmonella* Enteritidis in eggs and *E. coli* O157:H7 in beef, have been international in scope. Consequently, international agencies as well as a number of individual countries, have been working to develop more comprehensive and effective programs. Many of these programs have embraced the notion of a farm-to-fork approach.

The Food and Agriculture Organization (FAO), Office International des Epizooties (OIE), and the World Health Organization (WHO), are international agencies with interests in agriculture, animal health and public health, respectively. All have expressed interest in improving food safety from farm-to-fork. For example, the principal goal of WHO’s recent Global Strategy for Food Safety (1) is “To reduce the health and social burden of foodborne disease”, and one of the means with which it intends to achieve this goal is by “developing science-based measures along the entire food production chain that will prevent exposure to unacceptable levels of microbiological agents and chemicals in food”. These organizations have important facilitating roles, but many of the actions must be applied at the country or regional level. The following is a brief summary of the some of the country-specific approaches being used.

1. Farm-to-Fork Strategies in the European Union and United Kingdom

The European Union (EU) has an integrated approach to food safety that aims to assure a high level of food safety, animal health, animal welfare and plant health. The strategies taken have been identified as “coherent farm-to-table measures [with] adequate monitoring” (2). The EU’s farm-to-fork food safety objectives are designed to assure effective control systems and evaluate compliance with EU standards for food safety and quality, animal health, animal welfare, animal nutrition and plant health, both for member states and for countries exporting to the EU; to manage international relations with third countries and international organisations concerning food safety, animal health, animal welfare, animal
nutrition and plant health; and, to manage relations with the European Food Safety Authority (EFSA) and ensure science-based risk management.

In the United Kingdom (UK) the realization that a farm-to-fork approach to food safety was needed by food and farming industries alike has been reflected in developments in food legislation. UK regulators have stated that the government's mandate to ensure that consumers' interests were considered throughout the food chain was paramount and that it was appropriate that the main food regulation body, the Food Standards Agency, be required to adopt this food production continuum approach, and be structured accordingly (2).

2. Farm-to-Fork Strategies in the United States

In the United States an increased focus on food safety in the 1990's was a result of high profile outbreaks including *E. coli* O157:H7 in undercooked fast food hamburgers as well as unpasteurized juices. The National Food Safety Initiative, launched by presidential address in January 1997, was the American response to the need for a seamless, integrated food safety farm-to-fork system.

It was recognized that a farm-to-fork system would inevitably have gaps and it was important to address the gaps while strengthening the programs already in place. The United States has set out a variety of food-related functions and has divided them between Federal and State government agencies. In the United States, food safety is based on interactions between a number of federal agriculture, environmental and health organizations. Public health departments within state governments are also charged with being a part of the seamless system (4).

During his tenure, President Clinton strengthened the farm-to-fork approach by establishing new science-based, hazard prevention systems for seafood, meat, and poultry, the Food Quality Protection Act (an overhaul of pesticide regulation) and also by signing a new safe drinking water law. One of the American strategies is to bridge gaps in the monitoring of food safety systems. The United States Department of Agriculture’s (USDA’s) Food Safety and Inspection Service (FSIS) has stated that while their regulatory authority lies within slaughter and processing establishments, they recognize the need to work with government partners at the Federal, State and local levels, and with industry, to encourage steps that will address food safety along the entire farm-to-table continuum, as not every problem needs a regulatory approach (5). FSIS also works with producer groups and others to address effective interventions throughout the food system, not just in slaughter and inspection (6).

The United States has several national consumer food safety strategies such as regulation requiring a safe handling label to be placed on most raw meat and poultry products (7), the Thermy the Thermometer™ campaign, a meat and poultry hotline (1-800-535-4455), hotline for foods regulated by the Food and Drug Administration (FDA) (1-888-SAFEFOOD) and the Fight BAC!™ campaign.

3. Farm-to-Fork Strategies in Canada

The food continuum within Canada consists of the following four sectors: the primary production sector, the processing sector which includes harvesting and putting raw materials in a form the consumer can use, the distribution/retail/food service sector, and the consumer sector (Figure 2.1). Within each sector one can have sub-sectors, e.g. the processing sector can be divided into primary (slaughter), secondary (fabrication, grinding, etc), and ready-to-eat products (cooked sausage, etc.) and commodities which cut across all sectors include beef, pork, lamb, poultry, fish.
The processing sector has been under the most scrutiny, affecting meat inspection and other regulations. As Hazard Analysis Critical Control Point (HACCP)-based food systems evolved (discussed in detail below), more emphasis was placed on the safety of the raw materials. For example, conditions that contributed to contamination during the slaughter process, and feeding of ruminant-free by-product feeds to ruminants, had to be accounted for in the design of the HACCP plan.

One of the three main recommendations in a recent report to Health Canada entitled “Recommendations For The Development of Policy Related To Raw Foods of Animal Origin” (8) was to develop integrated risk-based food safety programs across the food continuum. While the emphasis was on raw foods of animal origin, this would also apply to all meat and fish products. It was stated that “the Government of Canada should encourage the development of risk-based food safety programs that adhere to or surpass internationally recognized food safety guidelines and principles. The programs should apply to all sectors of the food continuum, while reflecting each sector’s unique characteristics. Each program should include all the essential elements of a risk assessment. Food safety objectives (FSOs) must be established and hazards of the greatest risks prioritized to ensure the areas of greatest risks are effectively managed”. These food safety programs should be based on the principles embodied in HACCP systems (8).
Figure 2.1 – Sectors In The Farm-To-Fork Meat Continuum.

Food products that are traded interprovincially and internationally are regulated by the Canadian Food Inspection Agency (CFIA). Their food safety regulation programs address the safety and quality of all food products. Meat inspection programs are reviewed in later chapters and a complete description of CFIA programs is beyond the scope of this report, but is available on the CFIA website (http://www.inspection.gc.ca/english/index/fssae.shtml). CFIA also administer import controls on animals and foods that in some cases have a bearing on food safety (e.g. prevention of importation of BSE and other pathogens), but these controls are also important to animal and public health.

II. SOURCES AND CONTROL OF FOODBORNE PATHOGENS ON THE FARM

Pathogens can contaminate at any point along the food chain, including but not limited to, the farm. By understanding where potential problems exist, it is possible to develop strategies to reduce risks of contamination. In chapter 8 some of these strategies are presented in more detail in the form of two examples, BSE and *E. coli* O157:H7

The majority of pathogens associated with foods of animal origin exist as part of the natural microflora in the intestines of livestock and are excreted in feces. One notable exception is *Salmonella* Enteritidis, which sometimes colonizes the reproductive tract of chickens and can thus be found inside eggs from infected chickens. At the farm level, pathogens can be transmitted by contaminated feed, animal-to-animal via feces, from water (used for drinking by livestock or irrigation and washing in vegetable crops), human fecal contamination from spreading of raw septic waste, pests such as rodents, flies and birds, and physical surroundings such as crates, equipment and vehicles that have been
improperly sanitized. Feedlots and barns have been found to be positive for *E. coli* O157:H7 due to the presence the organism in feces (9).

The fact that many of these foodborne pathogens (e.g. *E. coli* O157:H7, *Campylobacter*) exist as part of the normal microflora of livestock presents special challenges for control. For example, most infected animals are not made ill and therefore farmers do not know their animals are infected. Since animals are not sick, veterinarians tend not to devise specific control programs on farms, and there has been little incentive to develop vaccines or other control measures. Consequently, livestock can appear to be perfectly “healthy” and yet harbour some important foodborne pathogens.

Season, geographic region, and animal age all affect the level of contamination on any particular farm. For example, contamination of animals with pathogens such as *Campylobacter* and *E. coli* is higher in the summer than winter, and higher in some geographical regions than others. Production practices can also influence the prevalence of foodborne pathogens in foods of animal origin. For example, in one study, free-range chickens were more likely to be contaminated with *Campylobacter* than conventionally reared birds (10).

Foodborne pathogens reach consumers by different pathways depending on the vehicle. With foods of animal origin, human illnesses are often caused by fecal contamination of raw animal products with pathogens such as *Salmonella*, *Campylobacter* and *E. coli*, as well as parasites such as *Trichinella spiralis*. In contrast, *Listeria* is most commonly associated with ready-to-eat foods as a result of cross contamination in the processing plant and subsequent growth in food (9).

Because of the potential for contamination at the farm level, intervention strategies should begin at the farm. While there has been an extensive focus on Good Manufacturing Practices (GMP’s) in food processing, only recently has there been an emphasis on Good Production Practices (GPP’s) and on-farm food safety programs.

### 1. On-Farm Food Safety Programs

A number of important foodborne diseases have been effectively control in whole or in part through on-farm control measures. Examples include bovine tuberculosis and brucellosis, which were controlled in Canada by a combination of on-farm testing and slaughter programs, trichinellosis in pigs, which was controlled in large part by restricting the feeding of food scraps to pigs, and some *Salmonella* infections in poultry, which were controlled by testing and slaughter and improved biosecurity of facilities. For each of these diseases, there were certain factors that facilitated effective control. In some cases, there were adequate tests available, and in others it was possible to identify critical control points where pathogens could be killed, or their life cycle could be effectively interrupted. Similarly, many chemical residue problems have been very effectively addressed by on-farm controls. For examples, it is known that risk of veterinary drug residues in meat is increased when these drugs are not used according to label instructions, and when proper withdrawal times for meat and milk are not followed. Critical points for control of these residues include use by properly trained individuals, and adequate treated animal marking, and record keeping.

Unfortunately, however, for many important food safety hazards, there are few evidence-based controls available, and therefore insufficient scientific support for identification of true critical control points. In these instances, it is important to identify GPPS that may provide some benefit while studies
into more science-based controls continue. It is important that encouragement is given to development of on-farm programs and that they start with the best controls and GPPs that are available that fit within a HACCP-based format. Once the programs are up and running, new science-based controls can be added as they become available.

In Canada, various commodities in the producer sector are making progress in developing on-farm food safety programs. The Canadian On-Farm Food Safety Program (COFFS) is a partnership between the federal government and national producer commodity associations with funding from Agriculture and Agri-Food Canada to help develop national programs, which are recognized by various jurisdictions. Examples of on-farm food safety programs being developed by national commodity organizations include Quality Starts Here for beef and Canadian Quality Assurance (CQA) for pork. Provinces have a key role to play through support and in some cases, delivery of these programs. Some producer groups have opted out of the national strategies as their buyers are demanding food safety programs today and cannot wait for development and implementation of a national program.

A good on-farm food safety program requires a variety of components that alone are perhaps inadequate to substantially reduce risk, but taken as a whole demonstrate that the producer is proactive about reducing food safety risks. This can be summarized as: write down what you do, do what you write, and prove it.

Researchers have identified three types of barriers to successful implementation of HACCP-based, on-farm food safety programs including: knowledge barriers - knowing about and understanding the program; attitudinal barriers - agreeing with the principles of the program and believing their actions will have an impact on food safety; and, behavioural barriers such as time, resources, money and staff (11). It is not enough to simply provide a set of guidelines and expect producers to comply with standards. Industry organizations and their producer members must be provided with ongoing information, a two-way dialogue, and support that will promote the adoption of new practices. Recent research has shown that producers prefer to have on-site visits when learning about food safety production practices, and will implement procedures correctly when shown in terms specific to their site. It has been argued that on-farm food safety programs should not waste money by putting producers in classrooms; rather, available funds need to be invested into effective on-site visits (12).

III. SOURCES AND CONTROL OF FOODBORNE PATHOGENS AT SECONDARY PROCESSING (OR READY–TO–EAT MEAT PRODUCTS)

Most microbial pathogens potentially associated with ready-to-eat meat and poultry products can be controlled by existing regulatory policies. These products are usually subjected to a kill step that eliminates pathogens such as *Salmonella*, *E. coli* O157:H7, and *Campylobacter jejuni*.

An exception is *Listeria monocytogenes* which continues to be detected on ready-to-eat products, mainly because of recontamination that occurs during processing. Current intervention strategies involve (1) control measures that minimize the bacterium’s establishment in equipment and (2) efforts to minimize the bacterium’s ability to transfer from a nonproduct contact surface to a location where it can contaminate products. Although these procedures can be effective, they require continual review and
frequent assessment through microbiological monitoring programs. One such approach to monitoring and controlling foodborne pathogens is the HACCP system.

IV. HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEMS

HACCP is a systematic approach to be used in food production and processing as a means to ensure food safety. The concept was originally developed by the Pillsbury Company in co-operation and with the participation of the National Aeronautics and Space Agency (NASA), the Natick Laboratories of the United States Army, and the United States Air Force Space Laboratory Project Group. Their objective was to produce minimal or no-risk foods for the United States space program.

The Codex Alimentarius Commission has an excellent treatise on the HACCP System and Guidelines for its Application (13). The HACCP system is science based, systematic, and identifies hazards and measures for their control to ensure food safety. It is a system that focuses on prevention rather than relying primarily on end-product testing. HACCP–based food safety programs can be applied throughout the food continuum from farm to plate, and its implementation should be guided by scientific evidence of risks to human health. The application of HACCP–based food safety systems can aid inspection by regulatory authorities and promote international trade by increasing confidence in food safety. HACCP is compatible with a variety of quality and risk management systems.

The HA in HACCP stands for Hazard Analysis, of which there are three main categories, biological, chemical and physical. The CCP stands for Critical Control Point which is defined as any point in the food system where loss of control may result in an unacceptable health risk. There are seven basic principles used in designing and implementing a HACCP system. PRINCIPLE 1 is to conduct a hazard analysis (HA); PRINCIPLE 2 is to determine the critical control points or CCPs; PRINCIPLE 3 is to establish the critical limit(s); PRINCIPLE 4 is to establish a system to monitor control of each CCP; PRINCIPLE 5 is to establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control; PRINCIPLE 6 is to establish procedures for verification to confirm that the HACCP system is working effectively; PRINCIPLE 7 is to establish documentation concerning all procedures and records appropriate to these principles and their application. The application of the basic HACCP principles are applied by following a logical sequence consisting of 12 steps.

The successful application of HACCP also requires the full commitment and involvement of management and the total work force. An important component of commitment is to provide resources for training. Even in a very small operation, it is important that all management and employees understand the basics and technicalities of the food safety program they are implementing and using. Management and employees should also participate in designing the program for their particular establishment. While it generally requires a multidisciplinary approach using expertise from veterinary medicine, animal production, microbiology, food science and technology, engineering, etc., the hiring of a reputable consultant with experience to help in the design of the HACCP-based food safety may be a worthwhile investment.

HACCP is now widely used in the food industries of many countries as the foundation for national and regional food safety programs. In Canada’s risk management system, it is one of the two major components of the Food Safety Enhancement Program, better known as FSEP (14). The other
component is the Prerequisite Plan that deals with those elements concerning the physical plant, equipment, and human resources. HACCP relates to raw materials, processes, and finished products. During the development of FSEP, it was determined that all required elements for a strong food safety program would not fit the HACCP protocol, thus the evolution of the prerequisite component.

Meat inspection regulations in North America were adopted during the first decade of the 20th century and HACCP–based food safety programs during the last decade of the 20th century. The responsibility for implementing and executing these types of food safety programs has shifted from government regulatory authorities to a shared responsibility between government and industry as part of the HACCP approach to food safety programs. While governments may provide the framework, and implementation and verification strategies, industry has the responsibilities for execution and maintenance of the programs. While consumers may still look to governments for protection, industry has a stake in food safety if it is to provide high quality food consistently to the marketplace. In recent years industry has also been faced with a number of recalls because of food safety problems and subsequent lawsuits.

Due diligence is an ancient legal concept. In the context of food production and processing, due diligence addresses the question of whether the producer and processor have done all that might reasonably be expected in the production of safe food. Due diligence can be seen as a radical concept in the area of food safety in that it implies that there can never be absolutely safe food, even with the implementation of HACCP systems. It focuses attention on the responsibilities of producers, processors and others in the farm-to-fork food safety system in preparing food for others, and in meeting a commonly accepted industry standard for food production. The onus is then for stakeholders such as government and industry to establish common standards such as GMPs, quality, and HACCP-based food safety systems, and the framework for their implementation by individual establishments.

If HACCP-based food safety programs are to be successful, current meat inspection and food safety management strategies should be integrated into one program. While traditional inspection is most important at the ante-mortem (animals just prior to slaughter) and post-mortem (after the slaughtering process and just prior to entry to the cooler) levels, food safety programs can effectively manage other matters which were previously included under inspection, e.g. product flow, temperatures, sanitation.

V. SOURCES AND CONTROL OF FOODBORNE PATHOGENS AT FOOD SERVICE AND RETAIL.

i. Food Handling and Preparation

Foodborne disease is multifactorial. This means that multiple factors (e.g. contaminated raw product, poor storage, faulty cooking, etc.) may contribute to increased risk of illness. Consistent with this is the observation from many epidemiological and surveillance studies that most cases of foodborne illness are associated with improper handling and preparation at retail, food service and in the home (15), although this does not abdicate the need to reduce food safety risks at all points along the farm-to-fork continuum. Underlying forces that may contribute to foodborne illness include insufficient training of food handlers (16). Food handlers play a significant role in the prevention of foodborne disease and must ensure there is no opportunity for potentially contaminated items coming into contact with foods that are to be eaten raw or foods that will not be subjected to further heat treatment (17). Food handlers must be
familiar with good hygiene practices, particularly if they have a wound or infection. Providing extensive food safety training and evaluation of food service personnel may be among the most fruitful food safety efforts. Therefore, understanding food safety is a must for everyone involved in the food system. A weak link anywhere from farm-to-fork can have devastating and far-reaching effects.

A particular challenge to the training of food handlers in food service and retail is the high employee turnover (9) and the difficulty in retaining properly trained employees for food safety related tasks. Further, food handlers, particularly in certain sectors of retail and food services such as fast food, are often young and paid minimum wage thus increasing some of the knowledge and attitudinal barriers to proper training.

ii. Food Service

Intervention strategies in food service must consider the breadth of organizations— from commercial establishments such as restaurants and food carts to non-commercial venues such as schools, hospitals, and prisons, as well as the range in size of operations from one-unit stores to international chains with more than 25,000 units (9). Challenges to such organizations include applying food safety controls uniformly across all sectors of the industry, maintaining minimal standards, and pursuing risk reductions for all types and levels of food service operations.

Standards should be met through partnerships with primary and secondary suppliers, and to establish credibility should be subjected to monitoring. Because safety in food service operations depends significantly on incoming food ingredients and products, primary suppliers need to extend their interest in food safety backwards down the supply chain, to farmers and to animal producers. At this level, expectations of food service operators include effective animal husbandry and agricultural practices, traceability systems, feed control, and irrigation and drinking water protection, as well as prudent antimicrobial use.

HACCP principles can also be applied in food service operations. For example, food safety can be enhanced through daily checks on key control points such as endpoint cooking temperatures, reheating temperatures, cooling times, sanitation practices, and personal hygiene. Verification of food safety procedures, whether conducted by local health departments, corporate representatives, or professional auditors, strengthen food safety systems by enhancing accountability and identifying opportunities for improvement.

The Canadian Restaurant and Food Services Association (CRFA) has facilitated the development of a national food safety tool kit, a standardized food safety training manual, the development of a National Certification Process and a Generic HACCP Model strictly for food service (http://www.crfa.ca/foodsafety/foodsafety_intro.htm).

iii. Retail

The United States Food and Drug Administration (FDA) has identified practices and behaviours affecting food safety at retail that need the most attention. These are control of time and temperature, proper sanitation of food-contact items, prevention of cross-contamination, and personal hygiene of food handlers. Traditionally, there have been few, if any, means to make food “more safe” once it reaches the supermarket. For most products at retail, there are few additional steps the retailer can take to eliminate, decrease, or prevent pathogenic contamination that has already occurred, beyond adherence to proper
refrigeration and raw food handling practices (9). However, the recent shift in retail toward serving foods cooked in-store and handling and preparing potentially hazardous ready-to-eat foods has created additional food safety management and monitoring steps, where previously, good retail practices (GRPs) were sufficient to maintain food safety.

iv. Food Safety in the Home

Consumers obtain food primarily from two sources, food service and retail outlets. Researchers have suggested that consumers know little about the various risks associated with food, risk management strategies that are taken by producers, processors, retailers, food service and government to reduce these risks, and what safe food handling practices need to be implemented in the home (9).

Consumer interventions to enhance safety, such as selecting safe food and handling food properly at home, require an adequate level of knowledge, consumer acceptance of safe food-handling responsibilities, and application of at-home safe food-handling practices. Since the 1990s food safety messages have been directed primarily at consumers (18). This is mostly due to the realization that foodborne illnesses are not just attributed to problems during food manufacture, but are also related to at-home food preparation.

While underreporting and poor surveillance systems make it impossible to obtain an accurate picture of where most cases of foodborne illness are contracted, most of the reported foodborne outbreaks in the UK, Europe, Australia, New Zealand, the United States and Canada have been associated with food prepared in the home. In Ontario, it is estimated that 50 per cent of sporadic cases between 1997 and 2001 were linked to a home setting (19) while the U.S. Centers for Disease Control and Prevention (CDC) reported that the majority of foodborne outbreaks in 2000 were linked to restaurants (40%) followed by caterers (20%) and multiple sources (15%) (20). It is important to note the difference between outbreaks (clusters of individual cases) and sporadic cases (individual cases), and that restaurants and fast food outlets are often associated with outbreaks of food poisoning but are rarely investigated as sources of ongoing sporadic infection, and that differing surveillance systems make international comparisons problematic.

Despite the efforts of food safety programs, foodborne illness is still a prevalent cause for disease at a national and international level. Multilevel community intervention programs can affect long-term knowledge and behaviours, however positive findings have not yet been seen. Such interventions have included:

- safe food handling labels placed on most raw meat and poultry products (USDA, 2002) focusing on cross-contamination, storing instructions and cooking temperatures
- Fight BAC!™ is a national educational campaign launched by the United States Partnership for Food Safety Education
- Thermy the Thermometer™ launched by FSIS to encourage consumers to use a cooking thermometer to ensure that meat is cooked sufficiently.
- national food safety hotlines In Canada, the Food Safety Network (21)
While many food safety programs offer quick solutions to food safety issues, many of these solutions contradict one another and are often disregarded by consumers. Consumers may also disregard food safety messages based on the level of language used. For example, the food safety program Fight BAC!™ uses the term cross-contamination in one of its four models. However, it has been found that the term cross-contamination is not understood by a majority of consumers. An evaluation of the Thermy the Thermometer™ campaign found that only 30 per cent of those who received the educational materials used a food thermometer while in another study only 64 per cent of participants recalled seeing the safe handling label and many of those had not read it. Not only do food safety messages need to be relayed but they also need to be reinforced on a regular basis and continually evaluated. Furthermore, food safety messages should be consistent, science based, frequent, and personalized (22).

VI. PRODUCT TRACKING THROUGH THE FOOD CHAIN

An ideal food safety system has an infrastructure to trace the origins and destinations of whole and processed food and their inputs. Open and transparent traceability of a food product can strengthen the management of food safety along the farm-to-fork continuum. Many epidemiological investigations of Canadian foodborne outbreaks are completed without discovering what went wrong. Illness investigations can only create a picture of a situation from what is known, and the links of products from consumption (in food service or the home) back through distribution, transportation and ultimately to the farm do not currently exist. A transparent traceability system can also bring the food production chain together and enable producers and processors to tell the story of how their food is grown or raised, what differentiates them on the market, and the safe conditions along the continuum.

The current fragmentation of the federal and provincial food system does not lend itself to a seamless tracking of products and because of this it is likely that commodity groups will create their own specific systems in response to buyer requirements. The technology to support a traceability system infrastructure is available, but the methods and barriers to effective implementation have been inadequately researched to date.

The Canadian Cattle Identification Agency was established in 2000 as a non-profit industry agency incorporated to establish a national cattle identification program. Cattle identification was made mandatory (punishable by industry-implemented fines) in July 2002 and all cattle must now carry a CCIA authorized tag identifying the farm of origin and other pertinent production data. Other commodity groups are working on similar programs as part of their on-farm food safety programs.

Quebec industry groups have implemented an identification and traceability system for farm produce. With support from the Québec Ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ), CO-OP Federation of Quebec (UPA), and La Financière Québec (FADC), Agri-Traçabilité Québec or ATQ was formed on September 21, 2001 to organize a permanent identification and traceability system for animal and vegetable products in the province. The objective of ATQ is to provide Quebec with an efficient management tool in case of a food safety crisis. The mandate of ATQ is to have traceability of beef and dairy animals from the farm to the plate by early 2005 and sheep and swine traceability from the farm to the slaughterhouse later in 2005. All animals must be identified within seven days of birth and every movement of each animal must be recorded throughout the life of the animal. The
ATQ system is fully compatible with the CCIA system, but more work has to be done to coordinate the efforts of the two organizations.

The next step in the process is at slaughter where the number on the ear tag is recorded and stays with each carcass up to chilling. It has been proposed that a “barn sheet” accompany the animal(s) to slaughter containing important information. Examples of relevant information for cattle might include the date of birth (to determine if the animal was born post ruminant feed ban), whether the animal has consumed any ruminant by-products, and whether any antimicrobials previously fed have been withdrawn at appropriate times. This system could also be implemented in provincially inspected plants with minimal difficulty, but there may be a nominal cost involved. Animal identification could be used to verify the information passed along to the processor and assist in obtaining information for certain recall situations. It would also be beneficial to validate the age of bovine animals where required for BSE control (i.e. to identify animals under 30 months and under 6-years-old (post-feed ban date)). Currently, dentition is used to age cattle, but this is not an exact science. Further, once the carcasses enter the fabrication room where they are cut into various cuts, individual animal identity is lost. If a tracking (or passport) system is introduced it would be possible to trace carcasses found to have illegal levels of antimicrobial or other regulated chemical residue back to the producer. Likewise it would be possible to trace carcasses with heavy bacterial pathogen contamination. Once the carcasses enter the fabrication room or where they are cut into various cuts, individual animal identity is lost.

The ownership and accessibility to data associated with the identity of shipped lots of products and even individual animals and produce units is problematic. For example, a recent project has found that it is difficult to access the birth dates of individual cattle to see if they were born pre- or post-ruminant feed ban. This was realized in December 2003 with the investigation into an American case of BSE traced to a Canadian herd. Data needs to be easily accessible to support food safety programs.

The Canadian Food Inspection Agency (CFIA) and industry leaders are researching new technology, such as DNA fingerprinting as a tool for traceability in the pork and dairy sectors. The Electronic Commerce Council of Canada’s Can-Trace Initiative has been defining and developing minimum requirements for national whole chain tracking and tracing standards based on the European Article Number and Uniform Council Code system standardized bar codes, EDI (Electronic Data Interchange) transactions, XML schemes, and other supply chain solutions for more efficient business. There are models and guidelines developed for meat and produce but this initiative focuses on the distribution, retail and food service sectors. These models need to be integrated with the CCIA program to link to the live animal identification. As more commodities design and implement these programs an examination of how traceability will best serve consumers and others is required so there is a tangible benefit for producers to participate.

VII. DEAD STOCK

Although not food for humans, dead animals and waste products from animal production are issues for food safety and public health, and also for animal health and the environment. Ontario's Dead Animal Disposal Act (DADA), which is administered by the Ontario Ministry of Agriculture and Food (OMAF), was put in place in 1960 to keep dead stock out of the food chain, protect the environment and water quality, eliminate health risks and help control wildlife populations that could feed on animal
carcasses that are not disposed of properly. Under the Act, livestock owners must dispose of a dead farm animal within 48 hours of death, either through burial under two feet of earth, through composting under two feet of dry organic matter in a properly designed composter (small carcasses) or through the services of a licensed dead stock collecting operation.

Dead stock removal services target cattle, swine and horses. Sheep and goats were excluded from the systems prior to 1997 as a precautionary measure in response to the BSE disease outbreak in Europe. Producers use burial and composting for these species.

In the past, dead stock collection services have generally been available to service farmers at no cost because the returns from the sale of dead stock by-products, i.e. hides, rendered products and meat, covered the cost of removal. However, markets started to fall in 1997. Cow hides currently sell for less than a half of the 1996 price, and there is a significantly reduced market for rendered products; they can be replaced by other commodities such as soybeans and palm oil whose prices are also severely depressed. It is expected that the depressed market for rendered products will continue. The price of dead stock meat is low and the products sold for use in pet food do not bring in enough money to offset losses in the other by-products. The closure of the American border to Canadian dead stock meat in 2003 effectively shut down the boned dead stock meat market for pet food.

i. Regulating the Livestock Disposal Industry

Under the Dead Animal Disposal Act (DADA), the Ontario government, through OMAF, licenses everyone involved in the dead stock industry – from collectors and receivers to rendering plants and brokers. Rendering plants are currently inspected by the Canadian Food Inspection Agency (CFIA) and reports are shared with OMAF. Those involved in the dead stock industry are not permitted to have any business relationships with the meat industry. Inspectors monitor activities and records in the dead stock receiving plants as part of a regular inspection program.

The Ontario dead stock industry is currently governed by the DADA and the accompanying regulations. Two new pieces of provincial legislation have been developed which are expected to replace the DADA: the Nutrient Management Act and the Food Safety and Quality Act. Regulations under the proposed Nutrient Management Act would address on-farm disposal of dead stock. Off-farm disposal of dead stock would be addressed by regulations under the proposed Food Safety and Quality Act.

There are four license-holder categories in Ontario, collectors (27 licences held as of March 2004), receivers (21), renderers (4) and brokers (3). Twenty of the 27 Collectors also hold a Receiver license. Essentially, 11 Collectors actively have vehicles on the road to transport dead stock.

(a) OMAF Structure to Administer the Legislation and Deliver the Program

The Program Manager, Policy and Audit Services of the Food Inspection Branch is the person in charge of the program. Reporting directly to the Program Manager is the DADA Coordinator; this individual provides the day-to-day oversight for the program. Approximately 31 meat inspectors are designated throughout Ontario to enforce the legislation.

The DADA Coordinator conducts inspections on the businesses and premises (receivers) of license holders. The reference document is the Standards of Compliance. Each license holder category is assigned a risk factor that is refined when the business volume is considered; this then determines the
frequency of inspections. Licensed renderers are regulated under the federal *Feeds Act* and as such are inspected once yearly by the CFIA. The CFIA inspection reports are provided to OMAF for their scrutiny. The DADA Coordinator uses the report to identify any deviations relative to the DADA; if there are deviations they are resolved with the rendering operator.

(b) Dead stock Disposal Complaints

A protocol has recently been produced to provide direction to OMAF, Ontario Society for the Prevention of Cruelty to Animals (OSPCA) and Municipal staff for complaints about the improper disposal of dead animals produced during operation of a livestock or poultry farm. It does not apply to wildlife or condemned animals from abattoirs. An earlier complaint protocol was developed for the use of Ministry of Environment (MOE) and OMAF in 1988.

i. Background

Dead animals are a normal by-product of farming operations because animals sometimes die from disease, accidents, or other causes. Sometimes, they are improperly disposed. Improper disposal can lead to unacceptable odours, insect problems, diseases transferred to other animals and humans, and water pollution. Worse yet, improper disposal can lead to a loss of public confidence in the livestock or poultry industry. All dead farm animals fit into one of two categories:

- Those covered under the Ontario *Dead Animal Disposal Act* (DADA) such as horses, sheep, goats, swine or cattle. This Act specifies that "the owner of a dead animal shall dispose of it within 48 hours of death by burial with a covering of at least two feet of earth, or by a person licensed as a collector under the Act, or by composting in an approved manner”.

- Those not covered under the current DADA include among others poultry, mink, ratites, farm pets, and rabbits. (Proposed legislative changes will include the species listed above.)

ii. Complaint Procedure

1. Complaints will mainly be received by OMAF’s Agriculture and Rural Division (ARD), OMAF’s Compliance Unit or the DADA coordinator, OSPCA, or local Municipal staff. These staff should determine the types of dead animals involved in the complaint and the nature of the complaint.

2. If the dead animals are covered under the DADA, then OMAF’s DADA Coordinator and/or Food Inspection Branch Inspectors (of which there are 30) take the lead. OMAF Agricultural Engineers and Livestock Advisors will provide technical assistance, if requested.

3. If the owner is known, he/she is held responsible for disposal.

4. If the owner is unknown and reaction time is critical because of the potential for water pollution, or if the carcass is in a highly visible location, OMAF Inspectors will either dispose of the dead animals, or continue to investigate the ownership.
5. If the dead animals are not covered by the DADA, the process for complaint follow-up remains the same (DADA Coordinator, Inspectors). OMAF Agricultural Engineers take the lead in remote areas of Northern Ontario.

6. If the owner is known, the owner is advised on acceptable disposal methods.

7. If the owner is unknown and reaction time is critical, the Municipality may arrange for disposal, and absorb the cost.

8. Regardless of animal type, complainants can apply to the Normal Farm Practices Board for odour, smoke or fly complaints about dead animal disposal methods.

The investigating inspector is encouraged to keep records on the events of his/her investigation. This will ensure that if charges are subsequently laid, a report will exist to support the charge. A suggested format is provided to the inspectors and is called the "Pre-Investigation Report". The DADA Coordinator maintains reports. If further regulatory action is contemplated, the reports are sent to the DADA Enforcement Advisor for the completion of an "Occurrence Report".

1. Current Financial Status

Table 2.1 shows the downward trend of prices of the three profit streams from dead stock since 1996. Today the situation is much worse, because at the time of writing, cow hides are only demanding $25 or less each and the pet food market for meat from dead stock is virtually eliminated.

Table 2.1  Trends in Prices for Inedible Animal Products 1996-2003.

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<tbody>
<tr>
<td>Cow Hides ($/hide)</td>
<td>53.00</td>
<td>48.25</td>
<td>33.00</td>
<td>23.00</td>
<td>40.00 to 45.00</td>
</tr>
<tr>
<td>Rendering (cents/ lb)</td>
<td>2.75</td>
<td>3.17</td>
<td>1.03</td>
<td>0</td>
<td>-1.50 to 3.00</td>
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<tr>
<td>Meat (cents/ lb) for pet food</td>
<td>18</td>
<td>18</td>
<td>18.5</td>
<td>20</td>
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At the time of writing, the average cost for each farm pickup charged by all collectors across Ontario was $28. Eighteen months earlier the average cost was $15 (almost doubled).

We were told that collectors are still in the business of picking up dead stock because of the funding they have been receiving from the "Healthy Futures" program support. Healthy Futures is funded jointly by OMAF and private agricultural business. Opinions from third party individuals have stated that even at $28 per pickup the collectors are losing money. The Healthy Futures program was depleted at the end of March 2004. Without the Healthy Futures support it is questionable whether most or all collectors will simply stop collecting. Any interruption in collecting will lead to accumulation of dead stock on the farm; in that case the only legal recourse for the producer is to bury his dead stock under 60 centimetres of soil or utilize composting.

When collectors increased the pickup charges over the past year, the volumes received reduced significantly. It is assumed that if the charges are increased again, the result will be even lower numbers of dead stock collected. The cumulative effect of this could lead to more violations under the DADA and
incidences that could result in environmental damage or embarrassment for commodity groups and the government.

Any person who contravenes the DADA or regulation is guilty of an offence. On conviction of a first offence, the individual is liable for a fine of not more than $2,000. For a subsequent offence, the individual is liable for a fine of not more than $5,000 or to imprisonment of not more than six months, or both. From April 2000 to November 2002 there were 17 charges, 10 convictions and a total of $6,100 in fines levied.

i. Reduced Risk of Fraud

The original reason for the creation of the DADA in the 1960s was to prevent the illegal (and unsafe) entry of inedible meat from dead stock into the human food chain. The closure of the Ontario market to the United States, along with reduced demand for meat from dead stock in pet food, has resulted in an almost no demand for the inedible meat. Now, with this major reduction in trade of boned-out dead stock meat, the threat of fraudulent entry of this product into edible product should be greatly reduced because dead stock operators will probably be closing down their boning operations in favour of alternative product streams.

ii. BSE Surveillance

Dead stock represents a high-risk target population of cattle for BSE surveillance. Brain samples can be obtained readily at receivers in a controlled atmosphere. Recently, rendering companies have declared they will not accept dead stock that has been used to sample for BSE unless the carcass is confirmed negative. Their concern is that detection of test-positive brain tissue from a carcass that has already been processed would result in a huge recall of rendered product. Since the test results are not received for a minimum of 96 hours, the tested carcasses need to be refrigerated at the receiver prior to rendering. Without product from boning, the receivers are not operating their freezers and do not want to hold the carcasses for the 96 hours. The end result is a reduction in the testing/monitoring for BSE.

iii. Composting

Under the DADA, producers can compost their dead stock. However, there is no provision for receivers to compost. Under the Meat Inspection Act abattoirs can compost inedible materials provided they receive OMAF approval. One receiver in Eastern Ontario was granted a temporary allowance to compost dead stock. Various individuals have assessed the operation and all agree it is successful. The cost is estimated to be one-third the cost of rendering. Because it may not be consistent with the DADA, OMAF decision-makers apparently have withdrawn permission to operate. This removes a potentially valuable disposal process in Eastern Ontario.

VIII. RENDERING INDUSTRY

Rendering of inedible animal by-products has been used for the last 120 years throughout the world as an accepted means of safely destroying animal tissue, for producing certain animal feed supplements, and separating fats and tallow for commercial and industrial use. This has been the traditional method of disposal of animal carcasses and other animal wastes from abattoirs, etc.
There are four holders of rendering licenses under the *Dead Animal Disposal Act* in Ontario. Two of the licenses are held by one company in two separate locations. This one company provides the major service based on the production volumes of rendered product.

As mentioned previously, the economic climate for receivers who process dead stock has deteriorated recently due to lower values for the hides and meat (used for pet foods) that are salvaged prior to rendering. Furthermore, the remaining carcass materials that are rendered have lower output values for the fat (yellow grease) and protein (meat and bone meal). These lower values are a direct result of a reduced demand by the feed industry for animal fats and proteins in feeds, in part due to concerns that pathogens, such as BSE, could possibly be present in the rendered material (especially the protein meals).

Recently, the Ontario government announced that it would eliminate the $0.143/litre provincial tax on biodiesel fuels. This tax reduction dramatically improves the return on investment for biodiesel production. The biodiesel industry would use yellow grease as its first feedstock (due to its low value in relation to other fats). After all of the yellow grease available in the province is utilized (as well as imported from neighbouring regions), vegetable oils such as soybean oil and higher value animal fats such as tallow could be diverted to biodiesel production. As a result, after biodiesel production increases, the value of yellow grease will increase to the cost of the next available alternative, such as higher value animal fats, or vegetable oils. This higher value will restore some profitability to rendering of dead stock. For example, with dead stock approximately 30% fats, and an increase in the value of yellow grease of $0.20/kg, this will increase the value of dead stock raw materials to renderers by up to $60 for every tonne of dead stock rendered. Other options for the use of rendered material include use as a fuel for heating of rendering operations or meat plants, heating of homes, or as an ingredient in concrete/cement.

i. Continuous System of Low Temperature – High Vacuum Rendering

Industrial rendering plants are driven by economics to improve efficiencies for extracting fat and drying meat and bone meal. Renderers are employing ever-increasing levels of vacuum, which allows for lower operating temperatures. As a result, the rendering processes have evolved from one of high temperature to one of low temperature under high vacuum. However, the existing continuous low temperature rendering systems do not eliminate drug residues or kill all pathogenic microorganisms with sufficient assurance to prevent disease from spreading. Thus, renderers do not want to process bio-waste streams that could potentially harbour the agents of Transmissible Spongiform Encephalopathies (TSEs). Because of this, most renderers refuse to pick up or utilize lambs, sheep, goats, zoo animals, mink and wild ruminants. Increasingly, they are more reluctant to process dead stock at all.

ii. Batch System of High Temperature - High Pressure Rendering

High temperature rendering, while an old process, is likely the only suitable process for ensuring most disease microorganisms are destroyed. High temperature – high pressure rendering is the only process suitable for use in Biosafety Level 4 laboratories, such as the federal government’s National Microbiology Laboratory at Winnipeg. It was selected only after exhaustive studies indicated that no other process could be consistently operated with known results, and would fail-safe in the event of a breakdown.
In the older versions of this technology, pressures and temperatures were rather low (0 to 45 psig or 1 to 3 atmospheres, and temperatures of 90 to 130°C), but still sufficient to kill most viruses and bacteria. However, it is now evident that some agents may be resistant to the temperatures employed in these older batch cooker designs. Therefore, newer designs are now required that operate at much higher temperatures and pressures. Designs are now proposed of up to 180 psig or 15 atmospheres, and temperatures of 180°C, which causes hydrolysis, completely breaking down product molecular structures.

Although not convincingly shown to our knowledge, the high temperature, high pressure rendering process may destroy prions and degrade drug residues. Presumably it kills all other known parasites, bacteria and viruses. This technology appears to be particularly suitable for swine disposal. A company called BioRefinex, operating out of Calgary, has a pilot facility and is conducting tests in the UK on the destruction of prions. If proven, this technology should be applicable for all livestock mortalities. This process is expensive to construct and operate, and requires a central site, thus necessitating the transportation of carcasses to the site, and incurring the associated costs. Even with this process, distribution of the resulting output should be restricted (e.g. to use as a fertilizer, depending on the possible pathogens remaining), when potentially contaminated bio-waste is processed.

References and Bibliography

5. Murano, E. Food Safety from Farm-to-fork: The Role of Irradiation Remarks prepared for delivery by Under Secretary for Food Safety, U.S. Department of Agriculture, before the First World Congress on Food Irradiation, May 5, 2003, Chicago, Ill


www.lapublichealth.org/acd/reports/annual/cd00/foodborne00.pdf

21. Food Safety Network Website: www.foodsafetynetwork.ca

CHAPTER 3

OVERVIEW OF MEAT PRODUCTION, PROCESSING, AND DISTRIBUTION

IN ONTARIO

I. FOOD ANIMAL PRODUCTION IN ONTARIO

To understand food safety throughout the food continuum in Ontario, and the role of provincial inspection, it is helpful to consider some basic information on animal production, slaughter and processing. Food-animal production in Ontario is a large, diverse and dynamic industry. Since World War II, the scale and intensity of farming have increased, with more animals being raised on fewer farms, especially among the major species (e.g. cattle, swine, chickens). However, there are wide ranges in farm sizes and types in the province and there are some animals raised on very small farms, mainly for the local market. Improvements in infectious disease control and better management and nutrition in animal production have facilitated these changes, but economic forces also play a role.

1. Beef

Beef calves are typically raised on cow-calf farms, which in Ontario have an average of about 30 cows. There are approximately 16,000 beef farms in Ontario and a total of approximately 1.6 million beef cattle. There are also approximately 7,500 dairy farms that contribute to the beef supply through cull cows and bull calves for veal. At about 6 to 8 months of age, beef calves raised on pasture are typically weaned, shipped to backgrounder (stocker) farms where they are fed forage-based diets, which are hay and silages in late fall, winter, and early spring, and pasture in late spring and summer. Some females (heifers) may be retained in the herd as breeding animals, which are called replacements. Backgrounder may also feed growing rations that contain less than 50% grain in the ration. Male calves are usually castrated to become steers primarily on the home farm where they were born or at the backgrounding operation. Steers and heifers will later enter feedlots where they are confined in large groups and fed high-energy rations containing greater than 50% grain, and supplemented with protein from plant sources, now that ruminant-derived protein is banned from ruminant feeds, and slaughtered at 14-24 months of age. Some weaned calves leave the cow-calf operation and are sent directly to feedlots for adjustment to high grain diets. Cows are typically culled from the herd and sent to slaughter if they fail to become pregnant or are defective (foot and leg problems, poor milk production, poor mothering ability).

The cattle population of Ontario has been fairly stable over the past few years at approximately 2-2.3 million head, but is expected to increase in light of the uncertain markets brought about by the BSE crisis beginning in May, 2003. In recent years, many cattle (and the vast majority of culled beef and dairy cows) were sold for slaughter outside of Ontario. This has changed recently with the BSE crisis, and live cattle shipment to the United States ceased in May 2003 and has not resumed at the time of writing. Most steers and heifers slaughtered in Ontario are processed in federally-inspected establishments; in 2002, 10-15% of this class was slaughtered under provincial inspection (Table 3.1).
Table 3.1. **Cattle Slaughtered in Ontario in 2002**

<table>
<thead>
<tr>
<th>Number of Animals</th>
<th>Federal Plants</th>
<th>Provincial Plants</th>
<th>Per Cent Provincial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steers</td>
<td>374,185</td>
<td>41,862</td>
<td>10.1</td>
</tr>
<tr>
<td>Heifers</td>
<td>169,714</td>
<td>30,039</td>
<td>15.0</td>
</tr>
<tr>
<td>Cows</td>
<td>507</td>
<td>11,258</td>
<td>95.7</td>
</tr>
<tr>
<td>Bulls</td>
<td>180</td>
<td>7,988</td>
<td>97.8</td>
</tr>
<tr>
<td>Total</td>
<td>544,586</td>
<td>91,147</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Source: Canfax Research; Livestock Inspection Branch, OMAFRA)
http://www.cattle.guelph.on.ca/statistics/cattle-proc-grad_ont.html Accessed March 1, 2004

2. **Veal**

Typically, bull calves that are culled shortly after birth from dairy herds, are used to produce red (grain fed) or white (milk fed) veal. On average, veal farms in Ontario produce 150-200 calves/yr. They may be housed outdoors in hutches, or indoors in individual stalls or group pens. Milk (or milk replacer) fed calves are typically marketed at approximately 205-227 kg. Grain fed calves, which are fed milk for the first 6-8 weeks of age then a grain-based diet, are generally marketed at 296-318 kg. In 2003, approximately 75,000 veal calves ranging in size from <50 - >280 kg were slaughtered in Ontario. In recent years, 50-77% of calves were slaughtered in provincially inspected plants. Some very young calves are slaughtered in provincially inspected plants with hide-on (so-called “bob” veal; <50kg) as a specialty product.

3. **Swine**

There are approximately 4,500 swine operations in Ontario. Swine are usually raised in pens, either on farrow-to-finish operations, which house the animals from birth to market, or in segregated management systems, where pigs are moved to different farms at various stages of growth (i.e., farrowing, nursery, and grower/finisher). Approximately 25% of pigs born in Canada are exported live at various ages to the United States. To help control the spread of infectious disease, many farmers practice “all-in-all-out” management, where all livestock in a barn are sent to another facility or to market and the barn is emptied, cleaned, and prepared for the next group of animals. The average size of operation is increasing in the swine industry, with many barns housing greater than 1,000 head. After weaning, pigs are fed a grain-based diet supplemented with protein from plant or animal sources. Pigs are sold through a marketing system in Ontario, mostly at 105-115 kg. The provincial production of pigs has remained fairly constant in recent years. Approximately 11% of the 3.5 million market hogs produced in Ontario are slaughtered in provincially inspected abattoirs. There is also a significant local market for “barbeque” pigs (approximately 30-50 kg) that are slaughtered almost entirely under provincial inspection (Table 3.2).
4. Poultry

Ontario has about 1200 commercial poultry farms that raise chickens and turkeys. Poultry is produced and sold under license on a quota system, and producers must have quota to market their chickens and turkeys unless it is for their own consumption. Chickens and turkeys are usually housed in confinement using all-in-all-out management, i.e. barns are completely emptied and cleaned before new flocks of uniform age are placed. Broilers and turkeys are typically raised in barns containing several thousand birds and are fed grain-based diets with plant and sometimes animal-derived protein supplements. Chickens are marketed at approximately 5-8 weeks of age and the majority weigh approximately 1.7-2.2 kg. Turkeys are marketed at 11-18 weeks at an average of approximately 5-14kg. Approximately 7.5% of the 200 million chickens and 2% of the 8.4 million turkeys produced annually in Ontario are slaughtered under provincial inspection (Table 3.3). There is also a significant specialty poultry market in Ontario (e.g. quail, pheasants, undrawn dressed poultry, Hong Kong dressed poultry) that is produced on a smaller scale and serviced almost exclusively by provincial inspection.

5. Sheep & Goats

There are approximately 300,000 sheep and lambs in the province and approximately 250,000 sheep and lambs and 25,000 goats are slaughtered annually, mainly (80%) in provincially inspected abattoirs. There are a variety of specialty markets for lambs, including light lambs for Christmas and Easter; heavier lambs are marketed later in the year.

Aquaculture

In 2000 there were approximately 190 private fish production facilities in Ontario. Rainbow trout is the principal species of fish raised commercially, with approximately 4,000 tonnes produced annually (figure 3.1). There are also small quantities of other species produced, including tilapia, arctic char, brook trout, bass and walleye.
Figure 3.1. Ontario Trout Production 1962-2000.

![Ontario Trout Production Graph](http://www.aps.uoguelph.ca/~aquacentre/aec/publications/aquastats00/aquastats2000.pdf)

http://www.aps.uoguelph.ca/~aquacentre/aec/publications/aquastats00/aquastats2000.pdf
(Accessed March 1, 2004)

6. Other Species

Other livestock commodities, including farmed deer, buffalo, elk, wild boar, rabbits and a variety of birds (e.g. ratites, ducks, geese, partridges) are also raised and slaughtered in Ontario, mainly under provincial inspection (Table 3.2).

<p>| Table 3.2. Red Meat Slaughter in Provincially Inspected Plants, Ontario, 1998-2003 |
|-----------------------------------|----------|----------|----------|----------|----------|----------|
| Livestock                         | 1998     | 1999     | 2000     | 2001     | 2002     | 2003     |
| Steers                            | 49,888   | 46,537   | 46,511   | 46,063   | 41,931   | 47,314   |
| Heifers                           | 43,119   | 38,812   | 34,761   | 32,720   | 30,072   | 29,551   |
| Cows                              | 11,492   | 10,315   | 9,709    | 10,446   | 11,262   | 14,376   |
| Bulls                             | 7,125    | 7,446    | 7,439    | 7,567    | 7,993    | 8,257    |
| Calves, male                      | 54,542   | 56,213   | 54,474   | 51,354   | 50,938   | 53,856   |
| Calves, female                    | 15,109   | 11,678   | 8,511    | 6,595    | 5,143    | 2,473    |
| Subtotal (cattle)                 | 181,275  | 171,001  | 161,405  | 154,745  | 147,339  | 155,827  |
| Market Hogs                       | 427,240  | 421,750  | 371,804  | 389,765  | 405,297  | 363,058  |
| BBQ Hogs                          | 151,798  | 161,594  | 148,191  | 142,087  | 143,686  | 149,658  |
| Sows                              | 33,302   | 30,416   | 25,532   | 16,255   | 13,324   | 8,873    |
| Stags                             | 1,167    | 893      | 1,360    | 904      | 393      | 362      |
| Boars                             | 32,755   | 32,254   | 27,672   | 32,180   | 45,596   | 43,548   |</p>
<table>
<thead>
<tr>
<th>Livestock</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ridglings</td>
<td>1,633</td>
<td>2,529</td>
<td>1,411</td>
<td>2,097</td>
<td>1,727</td>
<td>1,809</td>
</tr>
<tr>
<td>Subtotal (hogs)</td>
<td>647,895</td>
<td>649,436</td>
<td>575,979</td>
<td>583,288</td>
<td>610,023</td>
<td>567,308</td>
</tr>
<tr>
<td>Sheep</td>
<td>25,352</td>
<td>27,611</td>
<td>36,054</td>
<td>36,910</td>
<td>44,358</td>
<td>53,565</td>
</tr>
<tr>
<td>Lambs</td>
<td>121,649</td>
<td>146,500</td>
<td>166,019</td>
<td>172,384</td>
<td>192,171</td>
<td>209,304</td>
</tr>
<tr>
<td>Goats</td>
<td>18,393</td>
<td>19,512</td>
<td>21,725</td>
<td>22,629</td>
<td>25,668</td>
<td>29,889</td>
</tr>
<tr>
<td>Buffalo</td>
<td>70</td>
<td>102</td>
<td>99</td>
<td>108</td>
<td>170</td>
<td>218</td>
</tr>
<tr>
<td>Fallow Deer</td>
<td>399</td>
<td>409</td>
<td>358</td>
<td>495</td>
<td>683</td>
<td>335</td>
</tr>
<tr>
<td>Red Deer</td>
<td>149</td>
<td>214</td>
<td>304</td>
<td>517</td>
<td>844</td>
<td>578</td>
</tr>
<tr>
<td>Elk</td>
<td>26</td>
<td>96</td>
<td>189</td>
<td>245</td>
<td>341</td>
<td>756</td>
</tr>
<tr>
<td>Wild Boars</td>
<td>455</td>
<td>518</td>
<td>451</td>
<td>504</td>
<td>358</td>
<td>417</td>
</tr>
<tr>
<td>Lambs</td>
<td>121,649</td>
<td>146,500</td>
<td>166,019</td>
<td>172,384</td>
<td>192,171</td>
<td>209,304</td>
</tr>
<tr>
<td>Buffalo</td>
<td>70</td>
<td>102</td>
<td>99</td>
<td>108</td>
<td>170</td>
<td>218</td>
</tr>
<tr>
<td>Fallow Deer</td>
<td>399</td>
<td>409</td>
<td>358</td>
<td>495</td>
<td>683</td>
<td>335</td>
</tr>
<tr>
<td>Red Deer</td>
<td>149</td>
<td>214</td>
<td>304</td>
<td>517</td>
<td>844</td>
<td>578</td>
</tr>
<tr>
<td>Elk</td>
<td>26</td>
<td>96</td>
<td>189</td>
<td>245</td>
<td>341</td>
<td>756</td>
</tr>
<tr>
<td>Wild Boars</td>
<td>455</td>
<td>518</td>
<td>451</td>
<td>504</td>
<td>358</td>
<td>417</td>
</tr>
<tr>
<td>Subtotal (other livestock)</td>
<td>172,377</td>
<td>199,702</td>
<td>228,405</td>
<td>236,018</td>
<td>266,127</td>
<td>296,891</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>1,001,547</td>
<td>1,020,139</td>
<td>965,789</td>
<td>974,051</td>
<td>1,023,489</td>
<td>1,020,026</td>
</tr>
</tbody>
</table>


Table 3.3. White Meat Slaughter in Provincially Inspected Plants, Ontario, 1999-2003

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickens</td>
<td>20,653,030</td>
<td>16,313,205</td>
<td>16,936,447</td>
<td>15,537,237</td>
<td>15,106,089</td>
</tr>
<tr>
<td>Cornish Hens</td>
<td>96,097</td>
<td>107,171</td>
<td>100,669</td>
<td>119,614</td>
<td>83,334</td>
</tr>
<tr>
<td>Ducks</td>
<td>836,237</td>
<td>896,863</td>
<td>913,551</td>
<td>916,074</td>
<td>898,891</td>
</tr>
<tr>
<td>Fancy Poultry</td>
<td>.</td>
<td>-</td>
<td>21,995</td>
<td>56,335</td>
<td>75,659</td>
</tr>
<tr>
<td>Fowl</td>
<td>638,578</td>
<td>490,309</td>
<td>1,052,401</td>
<td>1,010,626</td>
<td>1,204,912</td>
</tr>
<tr>
<td>Geese</td>
<td>28,180</td>
<td>35,722</td>
<td>30,710</td>
<td>28,400</td>
<td>21,732</td>
</tr>
<tr>
<td>Guinea Fowl</td>
<td>476</td>
<td>6,750</td>
<td>3,598</td>
<td>6,089</td>
<td>1,062</td>
</tr>
<tr>
<td>Other White Meat</td>
<td>199,895</td>
<td>133,405</td>
<td>24,322</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Partridge</td>
<td>18,421</td>
<td>21,386</td>
<td>22,061</td>
<td>22,786</td>
<td>23,778</td>
</tr>
<tr>
<td>Pheasants</td>
<td>5,590</td>
<td>5,329</td>
<td>4,345</td>
<td>3,896</td>
<td>3,661</td>
</tr>
<tr>
<td>Pigeons</td>
<td>87,408</td>
<td>116,461</td>
<td>125,338</td>
<td>112,465</td>
<td>99,580</td>
</tr>
<tr>
<td>Quail</td>
<td>775,571</td>
<td>667,704</td>
<td>440,842</td>
<td>973,443</td>
<td>975,781</td>
</tr>
<tr>
<td>Rabbits</td>
<td>259,636</td>
<td>248,945</td>
<td>246,621</td>
<td>230,362</td>
<td>222,205</td>
</tr>
<tr>
<td>Silkies</td>
<td>-</td>
<td>-</td>
<td>46,741</td>
<td>52,384</td>
<td>50,123</td>
</tr>
<tr>
<td>Turkeys</td>
<td>241,372</td>
<td>217,943</td>
<td>272,228</td>
<td>205,243</td>
<td>201,546</td>
</tr>
<tr>
<td>Total</td>
<td>23,841,491</td>
<td>19,261,193</td>
<td>20,241,869</td>
<td>19,274,954</td>
<td>18,968,353</td>
</tr>
</tbody>
</table>

II. SLAUGHTER AND MEAT PROCESSING INDUSTRY

1. Red and White Meat Processing

Meat is slaughtered and processed in a variety of facilities in Ontario. Small numbers of animals are killed and dressed by citizens for their own use, but all meat for legal sale to the public must be slaughtered in a licensed establishment and inspected and approved by either federal (CFIA) or provincial authorities. In 1999 there were 33 federally inspected and 229 provincially inspected slaughter facilities (Table 3.4). Provincialy inspected slaughter facilities (also known as abattoirs, slaughterhouses) are located throughout the province. Some are “custom kill” operations that slaughter and perform basic butchering services for individual customers, while others carry out further processing (e.g. sausage, smoked meat manufacture) for sale to the public on premises or through other retail or foodservice outlets. Most of the operations (81%) are primarily “red meat”, i.e. beef and pork, and the remainder are primarily “white meat”, i.e. poultry, game birds, and rabbits. It has been estimated that 20% of slaughter in provincially-inspected plants is either custom slaughter for the animal owner’s own use (10%) or contract slaughter (10%) with resale by the farmer (1). Under current regulations, hunter-killed game animals may be butchered within licensed abattoirs, but special handling provisions apply. The carcasses must be segregated and it is suggested they be wrapped and kept separate from others in coolers etc., and operators must have a written policy on their handling procedures. There are currently no such requirements in free standing processing facilities.

### Table 3.4. Numbers and Distribution of Provincial Inspected Abattoirs, June, 1999

<table>
<thead>
<tr>
<th>Volume Level (Animal inspection units)</th>
<th>No. of Plants</th>
<th>Slaughter Only</th>
<th>Further Processing</th>
<th>Red Meat Plants</th>
<th>White Meat Plants</th>
<th>Single Species Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2,500</td>
<td>24</td>
<td>8</td>
<td>16</td>
<td>19</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2,500-5,000</td>
<td>38</td>
<td>11</td>
<td>27</td>
<td>33</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5,000-10,000</td>
<td>67</td>
<td>24</td>
<td>43</td>
<td>60</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>10,000-20,000</td>
<td>44</td>
<td>12</td>
<td>32</td>
<td>38</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>20,000-40,000</td>
<td>21</td>
<td>11</td>
<td>10</td>
<td>14</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>40,000-100,000</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>24</td>
<td>20</td>
<td>4</td>
<td>12</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>229</strong></td>
<td><strong>93</strong></td>
<td><strong>136</strong></td>
<td><strong>185</strong></td>
<td><strong>44</strong></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>

Source: (1)

Free standing meat processors in Ontario are manufacturing facilities that are not provincially licensed abattoirs nor federally registered establishments (both of which slaughter animals). They are included under the definition if they can be categorized as undertaking either of the following activities:

- cutting, boning, breaking, comminution (e.g. grinding, flaking, etc.), fabrication, cooking and repackaging of meat products; in addition, they distribute some portion of their products through any wholesale or retail outlet not connected to the processing plant; or

- by-product dressing for human consumption, (e.g. offal processing or singeing of beef feet/ skin), curing, fermenting, canning of meat products or vacuum packaging of high-risk meat products.
In 2002, OMAF conducted a survey and determined that there were 681 free standing meat processors in Ontario. They also conducted a preliminary assessment of potential public health risk based on the types of product produced. All 681 establishments produced meat products in the low-risk category (i.e. require further processing prior to consumption), which were basically raw meat products (e.g. primal and subprimal cuts (e.g. steaks and roasts), fresh sausage, ground beef). Some of the plants (n=401) produced medium-risk meat products, including fully cooked products, and smoked or cured products requiring further processing (e.g. cooking) prior to consumption. One hundred and nine establishments produced high-risk meat products, including ready-to-eat products that are cured, fermented, dried or canned. Many plants processed a combination of risk category meat products. Sources of meat for these establishments included federally inspected plants (84.7%), provincially inspected plants (65.2%), and less frequently, imported, hunted wild game, or other sources (2).

The survey determined that 82.8% of these free standing establishments distribute product on-site, 54% through hotels and restaurants, 25.8% through chain stores, and lesser numbers through institutions, wholesale, farmers markets, or other routes.

2. Fish Processing

A recent study identified 147 plants in Ontario that are classed non-federally registered fish processors, and therefore subject to provincial regulation (3). Many are seasonal operations that process from <10,000 kg to >250,000 kg per annum. Fish are acquired from commercial fisheries, aquaculture or are imported. Risk profiles of processors were carried out on the basis of product or process type: low risk (cleaning, filleting, freezing); or high risk (smoking, sushi preparation, canning, vacuum packaging). Approximately 50% of facilities engaged in high-risk processing (3). Most product is sold wholesale.

References and Bibliography
CHAPTER 4
PUBLIC HEALTH HAZARDS IN MEAT AND TRENDS IN FOODBORNE ILLNESS

Most food consumed in Ontario is nutritious, wholesome and free from harmful contaminants. Nevertheless, there is always a potential for contamination, and in Ontario as well as other regions and countries around the world, it is well known that foods from both animals and plants are potential sources of a wide range of disease-causing infectious and non-infectious agents. This chapter seeks to provide an overview of foodborne hazards, including their identity, disease-causing capabilities, association with various foods, and frequency of association with human illness.

I. INFECTIOUS AND NON-INFECTIONOUS (CHEMICAL, PHYSICAL) HAZARDS

The infectious agents of concern to food safety are microbes capable of infecting people and causing illness. These agents include bacteria and their toxins, viruses, parasites and prions (which have some, but not all characteristics of infectious agents). Some of these agents occur naturally in the environment (e.g. water, soil), and others are normally resident in animals or humans. The non-infectious agents of importance to food safety include toxic chemical compounds or elements, and physical hazards, such as metal objects, glass or other physical materials. Some chemicals may occur naturally in the environment, however many are man-made and contaminate foods through accident, environmental pollution or misuse.

1. Infections from Animals (Zoonoses)

Meat is derived from animals, therefore it is important to consider the risk that animal diseases pose to humans. Actually, many infections of animals are thought to be completely harmless to humans. In Canada, most of the economically-important diseases of meat-producing livestock (e.g. pneumonia, diarrhea, skin infections) are caused by strains of organisms that do not cause illness in people. However, some infections of animals are naturally transmitted between other vertebrate animals and people. These are called zoonoses, and out of 1,709 known infectious microbial agents nearly 50% are zoonotic. Some have been recognized for many years (e.g. rabies, salmonellosis, plague, anthrax), while others are newly emerging or re-emerging. Emerging infectious disease is an increasingly important threat to public health. It has been estimated that of recently emerging pathogens, 73% are zoonotic (e.g. West Nile virus, Avian Influenza virus, and probably the SARS and AIDS viruses). There are a number of possible reasons for the development of emerging infections, including enhanced detection capabilities (i.e. better tests), increased travel and international trade in animals and food, increasing diversity of foods, climate changes, and more susceptible populations (1).

Some of the zoonoses, both the “older” and emerging type, may be transmitted through foods to humans, but others are not, or only under extremely rare conditions. To some extent this is related to their ability to survive outside of a living host in food matrices, or may be related to the infectious “dose” or numbers of organisms required to cause human infection. Most zoonotic viruses, for example rabies, do not survive well in foods, and for human infection to occur usually there must be close or direct contact.
with an infected animal, such as a bite, scratch, or inhalation of dander or dust from an infected animal (these may be important routes of occupational exposure for animal handlers or abattoir workers). Rabies, Avian Influenza (“bird flu”), West Nile virus, and SARS are examples of high-profile zoonoses that are not thought to be transmitted through foods. Other zoonoses, however, are partly or entirely foodborne (e.g. *Salmonella*, *Campylobacter*, Toxoplasma, BSE).

2. Infections from Humans

Humans are a potential source of infection for other humans, and food and water have traditionally been important vehicles of human-derived infections, especially where there is a lack of proper sewage and water treatment, or poor hygiene practices. Shigellosis, cholera, Hepatitis A infection, amebiasis, norovirus infection (Norwalk virus) and staph food poisoning are examples of food or waterborne illnesses that originate from infected humans. These infections can contaminate food through sewage-polluted water (e.g. Hepatitis A from shellfish), by poor sanitation by infected food handlers (e.g. shigellosis) or a combination of poor hygiene and faulty food handling (e.g. staph food poisoning). Many important infectious diseases of humans do not, however, appear to be transmitted through foods (e.g. AIDS, Hepatitis B, pneumococcal infection).

3. Meat as a Source of Microbial Foodborne Infections and Intoxications

Microbial agents are responsible for by far the greatest proportion of reported foodborne illnesses in Ontario and other developed regions. The following is a summary of important microbial infections and intoxications, their symptoms in people, sources, and methods of control (adapted from (2-6)). Tables 4.1-4.5 describe various aspects of foodborne illness, microbial contamination of meat and factors affecting microbial growth in foods. Figure 4.1 shows some of the risk factors for foodborne illness, and figure 4.2 shows the ecology of the food chain. All of these are related to the epidemiology of foodborne illness.

**BACTERIA**

*Bacillus cereus*

*Disease summary:* Two recognized types of illness are caused by *Bacillus cereus*. A large molecular weight toxin causes the diarrheal type of illness, while the vomiting type of illness is believed to be caused by a heat stable peptide.

*Symptoms:* The symptoms of the diarrheal illness mimic those of *Clostridium perfringens* with the onset of watery diarrhea, abdominal cramps, and pain occurring 6 - 15 hours after consumption of contaminated food. Nausea may accompany diarrhea, but vomiting rarely occurs. Symptoms are transient and last for 24 hours. The emetic type of illness is characterized by nausea and vomiting within 0.5 - 6 hours after consumption of contaminated foods. Occasionally, abdominal cramps and/or diarrhea may also occur. Again, these symptoms last less than 24 hours.

*Source:* A wide variety of foods including meats, milk, vegetables, and fish have been associated with the diarrheal illness, whereas the vomiting type is associated with starchy foods, especially rice.
**Modes of Transmission:** The bacteria are mainly transmitted through ingestion of foods that have been temperature.

**Control:**

- Practice proper handwashing.
- Rapidly cool foods.
- Cool foods in small quantities
- Wash foods prior to preparation.

**Campylobacter jejuni**

**Disease Summary:** *Campylobacter jejuni* is the leading cause of bacterial diarrheal illness in Canada and the United States.

**Symptoms:** Symptoms may appear 2 to 5 days after eating the contaminated food and may last up to 7 to 10 days; these symptoms include fever, headache, and muscle pain followed by diarrhea, abdominal pain, and nausea.

**Mode of Transmission:** Contaminated water, raw milk, and raw and undercooked meat, poultry or shellfish have all been associated with campylobacteriosis.

**Source:** This bacterium is present in the intestinal tracts of healthy chickens and turkeys and this can result in the contamination of raw poultry. Raw milk can also be a source as the bacteria are carried by healthy cattle and by flies on farms. Infection may also arise due to drinking non-chlorinated water. However, properly cooked chicken, pasteurized milk, and chlorinated drinking water are generally safe.

**Control:**

- Avoid cross-contamination of foods.
- Cook foods thoroughly.
- Practice good personal hygiene.
- Only consume pasteurized milk products.

**Clostridium botulinum**

**Disease Summary:** *Clostridium botulinum* is an anaerobic (grows in the absence of oxygen), gram-positive, spore-forming rod that produces a potentially lethal toxin. The spores are heat resistant and can survive in foods that are incorrectly or minimally processed. Foodborne botulism is a severe type of food poisoning caused eating foods containing the potent toxin formed during the growth of the organism.

**Symptoms:** Symptoms usually appear 2 to 36 hours after ingestion of food containing the toxin, but sometimes take as few as 2 hours or as long as 8 days to develop. The disease is characterized by double vision, droopy eyelids, trouble speaking and swallowing, difficulty breathing and paralysis. It is often fatal.
**Source:** The organism and its spores are widely distributed in nature. They occur in soils, sediments of streams, coastal waters, and in the intestinal tracts of fish and mammals, and in the gills and viscera of crabs and other shellfish.

**Mode of Transmission:** The toxin of *Clostridium botulinum* has been detected in a variety of foods such as canned corn, peppers, green beans, soups, smoked fish, improperly canned foods, garlic in oil, vacuum-packaged and tightly wrapped foods.

**Control:**
- Use only commercially canned or smoked products.
- Refrigerate olive oil and garlic.
- Discard bulging canned goods.
- Refrigerate foods.
- Rapidly chill in small quantities.

*Clostridium perfringens*

**Disease Summary:** *Clostridium perfringens* is widely distributed in the environment and frequently occurs in the intestines of humans and many domestic and wild animals. The organism produces spores which are heat resistant and may persist in soil, sediments, and areas polluted by human and animal feces. The illness is due to a toxin produced by the organism during growth in the human intestines.

**Symptoms:** *Clostridium perfringens* can cause diarrhea and abdominal pains due to gas formation about 8 to 24 hours after eating. The illness is transient and usually lasts 1 day, but some symptoms may last 1 to 2 weeks in the elderly or very young.

**Source:** The bacteria can be found in soil, dust, sewage, and intestinal tracts of animals and humans. The organism requires little or no oxygen for growth.

**Mode of Transmission:** *Clostridium perfringens* infection is usually the result of eating foods that have experienced temperature abuse. Cooking can destroy the bacteria, but spores of the organism may survive.

**Control:**
- Cool foods rapidly in small quantities.
- Avoid preparing foods hours in advance.
- Reheat foods rapidly to a minimum of 73.9°C/165°F.
- Proper cleaning and sanitizing of equipment.
- Avoid using leftovers.

*E. coli* O157:H7

**Disease Summary:** *E. coli* are part of the normal bacterial flora found in the large intestine of animals, and *E. coli* O157:H7 is one of many strains of the organism. It was first
recognized in the United States in 1982 and since then has been associated with several serious outbreaks, many of which have been associated with undercooked ground beef.

**Symptoms:** Symptoms usually involve severe abdominal pain, cramps, nausea, vomiting, diarrhea and occasionally fever. The illness can evolve into Hemolytic Uremic Syndrome (HUS), which is a serious disease and is the leading cause of kidney failure in children. Other consequences of infection may include central nervous system disease, seizures, coma and blood clots in the brain and these may result in death.

**Source:** Whereas *E. coli* O157:H7 occurs in both humans and animals; only humans exhibit symptoms of illness. The organism resides in the intestinal tract and is shed in the feces. Food can be contaminated during slaughter and milking. While roasts and steaks may become contaminated, the bacteria usually only reside on the exterior of such products, and are killed if the meat is properly cooked. However, with hamburger and other ground meat products or mechanically tenderized meats, the bacteria may be evenly distributed throughout the product. If the product is not thoroughly cooked, some organisms may survive. Illness can occur after ingesting only small amounts of this pathogen. *E. coli* O157:H7 has been isolated from raw and undercooked meats, cheeses, lettuce, unpasteurized milk, raw finfish, cream pies, mashed potatoes and other prepared foods. Fruits, vegetables and other foods may be contaminated by uncomposted manure-based fertilizers, contaminated water or other sources.

**Control:**
- Food safety education
- Cook meats thoroughly, until the juices run clear. (68.3°C/155°F for ground meats/hamburger)
- Avoid cross-contamination (contact of raw food with cooked foods)
- Good personal hygiene with an emphasis on handwashing

**Listeria monocytogenes**

**Disease Summary:** Listeriosis is caused by the bacterium *Listeria monocytogenes* that is frequently found in soil, water and plant matter. It is of particular concern because it can survive and grow in moist, cool locations such as refrigerators. *Listeria* is very difficult to eliminate from the environment because of its ubiquitous nature. However, it is destroyed by thorough cooking. Listeriosis can be a severe illness for the old, very young and for people who are immunocompromised. It is a particular hazard for pregnant women as it can lead to miscarriage and still-births.

**Symptoms:** Listeriosis can involve nausea, vomiting, headaches, delirium, coma, collapse, shock and lesions in vital organs and may result in severe mental retardation, meningitis and death in newborns.

**Source:** The most likely sources for *L. monocytogenes* are wild and domestic mammals, fish and fowl, although the organism is widespread in the environment.

**Mode of Transmission:** People infected with listeriosis may excrete the bacteria in their feces; thus personal hygiene is extremely important. Improper sanitation of refrigerators may
increase spread of listeriosis, and dish cloths have been found to be frequently contaminated with the organism. Certain cheeses (mainly soft cheese such as Brie and Camembert) made with unpasteurized milk may support the growth of Listeria during ripening and has been implicated in serious outbreaks. Other sources include paté and smoked fish.

**Control:**
- Food safety education
- Good personal hygiene and handwashing
- Keep things dry. *Listeria* can grow on wet floors, in drains, in ceiling condensates and on sponges
- Proper cleaning/sanitizing of equipment
- Washing vegetables/produce
- Avoiding contact between raw and cooked foods

**Salmonella**

*Salmonella* is another bacterium that lives in the intestines and is commonly found on raw meats, poultry and in eggs, or in foods containing raw milk or egg products. There are hundreds of *Salmonella* serotypes (or species), and *S. Typhimurium* and *S. Enteritidis* are among the most common. *Salmonella* is killed by heating at 54.4°C/130°F or above for 2 hours, or at 73.9°C/165°F for a few seconds. A person with Salmonellosis who may not show symptoms of the disease can transmit the disease to others for up to several days to several months via cross-contamination of food and/or inadequate handwashing after toilet use.

**Symptoms:** People with salmonellosis generally exhibit the following symptoms: headache, abdominal pain, diarrhea, nausea, vomiting, dehydration, fever and loss of appetite, which commonly appear within 6-72 hours after the ingestion of the organism and may persist for as long as 2-3 days. Death is uncommon, but may occur in the very young, very old and the immunocompromised.

**Source:** Humans and domestic or wild animals: poultry/eggs, swine, cattle and rodents, and pets such as turtles, chicks, dogs and cats can all harbour the bacterium. Humans can be carriers (have and transmit the disease without showing symptoms) and may shed the disease in the feces for up to one year.

**Mode of Transmission:** Illness is the result of ingestion of foods containing the bacteria. The sources are usually undercooked meats or eggs, contaminated food or tableware, and untreated public water supplies.

**Control:**
- Food safety education
- Good personal hygiene and handwashing
- Proper cooking temperatures
- Proper cleaning/sanitizing of food equipment
• Prevention of sick employees from handling foods

_Shigella spp._

**Disease Summary:** Shigellosis, commonly called dysentery, is a bacterial infection caused by eating contaminated raw produce and moist ready-to-eat foods such as potato, tuna, turkey and macaroni salads that have been mishandled during preparation by an infected person. Contaminated water has also been identified as a source of this illness.

**Symptoms:** Symptoms of the illness usually include diarrhea, cramps and chills, and these are often accompanied by fever. These symptoms usually develop within 12-96 hours, but can take as long as one week. The illness usually lasts 4-7 days.

**Source:** The most significant source of infection is humans. Asymptomatic carriers and affected people may excrete this pathogen in their feces for several weeks, and be able to transmit the illness to others for months, or longer.

**Mode of Transmission:** The bacteria are usually spread by people with poor handwashing habits after toilet use, who subsequently contaminate food. Flies have also been known to transfer the disease from feces to water, milk and food. It only takes a small number of bacteria (10-100 individual bacterial cells) to cause illness.

**Control:**
- Food safety education
- Good personal hygiene and handwashing
- Fly control
- Remove employees with the illness from food handling duties until cleared by a physician

_**Staphylococcus aureus**_

**Disease Summary:** Staphylococcal food poisoning is the result of ingestion of toxins that are produced by _Staphylococcus aureus_. The illness usually lasts only one or two days, but occasionally the severity of the symptoms requires the patient to be hospitalized. However, deaths are rare.

**Symptoms:** Staphylococcal food poisoning usually causes nausea, vomiting, diarrhea, dehydration, prostration, cramps, subnormal temperatures and lowered blood pressure and these symptoms appear within 30 minutes to 7 hours (2-4 hours is most common) after eating the contaminated food. Symptoms may last for up to 24-48 hours.

**Source:** _Staphylococcus aureus_ capable of producing enterotoxin is most commonly associated with humans, but cows, dogs and fowl also can be a source. It is estimated that 40-50% of healthy adults carry staphylococci in their nasal passages and throats, and on their hands and skin. These bacteria also are found in infected cuts, boils, burns, abrasions and pimples.
**Mode of Transmission:** Staphylococcal poisoning is most commonly caused by ingestion of contaminated ready-to-eat, high-protein foods such as meat, poultry and dairy products which have been stored at incorrect temperatures.

**Control:**
- Food safety education
- Good personal hygiene with an emphasis on handwashing and minimal food handling
- Food stored at proper temperatures.
- Cool potentially hazardous foods to 5°C/41°F within 6 hours (62.8°C/145°F-21°C/70°F in 2 hours and 21°C/70°F-5°C/41°F in an additional 4 hours.)
- Potentially hazardous foods at room temperature should be discarded after 4 hours
- Prevent food handlers with cuts, abrasions, pimples, boils or upper respiratory symptoms from handling food.

**Vibrio vulnificus**

**Disease Summary:** The bacterium *Vibrio vulnificus* occurs naturally in coastal waters throughout the world and may be present at higher levels during the summer. In the U.S., 5-10% of all shellfish may be contaminated with *Vibrio vulnificus*. Currently, there are no practical methods available to eliminate *Vibrio vulnificus* from coastal waters or from shellfish harvested from these waters. *Vibrio vulnificus* does not pose a risk for most healthy adults; however, the bacterium can cause very severe illness in immunocompromised individuals such as the young, the elderly and persons with liver disease.

**Symptoms:** The illness usually results in fever, chills, nausea, vomiting, diarrhea, shock, abdominal pain and severe fatigue. There may also be localized skin or blood infections, which can progress to sores or ulcers. Onset of symptoms is rapid, usually occurring within 3 days after ingestion of the bacterium. The infection can cause severe illness with a high mortality rate in immunocompromised persons.

**Source:** In N. America, *Vibrio vulnificus* is most commonly isolated from warm coastal waters, such as those around the Gulf of Mexico, but it has also been found in water from both the Atlantic and Pacific coasts.

**Mode of Transmission:** *Vibrio vulnificus* is transmitted to humans through consumption of improperly cooked or raw shellfish harvested from infected waters, or through open wounds in contact with seawater.

**Control:**
- Food safety education
- Avoid exposure of recent or healing skin abrasions to seawater
- Immunocompromised individuals should avoid consumption of raw or undercooked shellfish and ensure the shellfish is thoroughly cooked
- Proper cleaning/sanitizing equipment to avoid cross-contamination of raw shellfish and cooked foods
• Good personal hygiene with an emphasis on handwashing
• Using shellfish from approved sources, although this does not guarantee that they are free from *Vibrio vulnificus*.

**VIRUSES & PRIONS**

**Hepatitis A**

*Disease Summary:* Hepatitis A is a virus and is a communicable disease that may be transmitted through food, but is also transmitted through person-to-person contact. Places such as daycare centers and hospitals are particularly vulnerable. Transmission may be due to persons who do not adequately wash their hands after using the toilet, or by consumption of raw or undercooked shellfish from contaminated waters. In the foodservice industry, Hepatitis A can be controlled by proper training and effective supervision of employees to ensure good hygienic practices, proper handwashing and safe handling of food and tableware.

*Symptoms:* Symptoms include abrupt fever, fatigue, loss of appetite, nausea, abdominal discomfort, jaundice, dark urine and joint aches, and these may appear within 15-50 days of exposure. The greatest risk of illness transmission from an infected person occurs one week before until one week after symptoms first appear.

*Mode of Transmission:* As well as person-to-person via the fecal-oral route, outbreaks due to contaminated water; food contaminated by infected foodhandlers, especially food that is not cooked after handling; and raw or undercooked shellfish from contaminated waters have been reported.

*Control:*

• Food safety education
• Minimize handler contact with food and food contact surfaces
• Good personal hygiene and handwashing
• Use of approved food sources
• Proper food cooking temperatures
• Vaccines are available for active immunization
• Prevention of infected employees from handling foods

**Norovirus (formerly known as Norwalk virus)**

*Disease Summary:* Norovirus is another virus whose transmission is usually associated with poor personal hygiene and contaminated soils or water. Although viruses do not grow in food, food can be contaminated via hands, soil or water. Norovirus is not easily killed by cooking and so it is important to prevent contamination of food.

*Symptoms:* Norovirus infection is characterized by nausea, vomiting, diarrhea, abdominal pain, headache and low-grade fever. The symptoms usually appear 24-48 hours after infection, and may persist for as long as 1-2 days.
**Source:** Man is the only known source of the virus. The virus is found in the feces of an infected person.

**Mode of Transmission:** Poor personal hygiene/lack of handwashing after toilet use and drinking contaminated water are the most common mode of transmission. Norovirus outbreaks have been caused by raw shellfish harvested from contaminated waters, contaminated ready-to-eat foods, eggs and even ice.

**Control:**
- Food safety education
- Good personal hygiene and handwashing
- Food and water from reputable sources
- Washing raw vegetables

**Variant Creutzfeldt-Jacob Disease and Bovine Spongiform Encephalopathy (BSE)**

**Disease Summary:** Variant Creutzfeldt-Jacob Disease (Variant CJD) is a fatal illness believed to be caused by an abnormal form of protein called a prion. One case has been detected so far in Canada, although this person is believed to have been exposed in the U.K.

**Symptoms:** Affected patients develop nervous symptoms, including anxiety, depression, and behavioural changes. As the disease progresses there are motor difficulties, involuntary movements and mental deterioration. Patients live on average for about a year after the onset of symptoms.

**Source:** Scientific evidence has linked this disease in humans to Bovine Spongiform Encephalopathy (BSE or “Mad Cow Disease”) in cattle. BSE is also believed to be caused by a prion. Evidence indicates that BSE is transmitted to cattle through feed contaminated with meat and bone meal derived from BSE-infected cattle.

**Mode of Transmission:** Consumption of contaminated beef products is believed to be the mode of transmission for Variant CJD. The available scientific evidence suggests that some, but not all, tissues from cattle with BSE may contain infective material. These tissues are called Specified Risk Materials (SRM) and include the skull, brain, trigeminal ganglia, eyes, tonsils, spinal cord and dorsal root ganglia of cattle aged 30 months or older, and the distal ileum of cattle of all ages. SRMs are now excluded from the human food chain in Canada.

**Control:**
- Prevent the use of ruminant-derived meat and bone meal in ruminant feeds
- Identify and remove suspect animals at ante-mortem inspection
- Remove specified risk materials from the food chain
- Conduct BSE surveillance in cattle, and trace and eliminate infected animals
Table 4.1. Characteristics Of Diseases Caused By Foodborne Organisms And Toxins (adapted from (1)).

<table>
<thead>
<tr>
<th>Organism/toxin</th>
<th>Incubation period</th>
<th>Disease severity</th>
<th>Duration</th>
<th>Sequelae</th>
<th>Fatality: case rate (%)</th>
<th>Toxic or infectious dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VIRUSES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>1-7 weeks</td>
<td>Moderate/severe</td>
<td>Weeks-months</td>
<td>?</td>
<td>0.3</td>
<td>?</td>
<td>Shellfish &amp; infected food handlers</td>
</tr>
<tr>
<td>Norovirus</td>
<td>1-2 days</td>
<td>Mild/moderate</td>
<td>1 to 2 days</td>
<td>-</td>
<td>0</td>
<td>?</td>
<td>Shellfish &amp; infected food handlers</td>
</tr>
<tr>
<td><strong>BACTERIA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aeromonas hydrophila</td>
<td>-</td>
<td>Mild, self-limiting</td>
<td>Days-weeks</td>
<td>Yes</td>
<td>-</td>
<td>?</td>
<td>No confirmed foodborne illness; strong epidemiological evidence</td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td>Diarrheal: 8-16h</td>
<td>Mild, self-limiting</td>
<td>1 day</td>
<td>-</td>
<td>0</td>
<td>$10^7 - 10^{11}$/100g food</td>
<td>Emetic illness associated with cooked rice and pasta</td>
</tr>
<tr>
<td>Campylobacter jejuni/coli</td>
<td>1 – 7 days</td>
<td>Mild to moderate</td>
<td>Days</td>
<td>2 to 10%; Guillain-Barre syndrome</td>
<td>0.05</td>
<td>$\geq 500$</td>
<td>Associated with raw milk, poultry, beef, pork and shellfish</td>
</tr>
<tr>
<td>Clostridium botulinum</td>
<td>12 – 36 h</td>
<td>Severe</td>
<td>Days to months</td>
<td>-</td>
<td>7.5</td>
<td>Up to about $10^9$ LD$_{50}$/mg toxin in mice</td>
<td>Home-canned or fermented foods. Most due to vegetables, meat and fish</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>8 – 16 h</td>
<td>Mild, self-limiting</td>
<td>1 day</td>
<td>-</td>
<td>&lt;0.1</td>
<td>$10^7 - 10^{10}$</td>
<td>Most outbreaks due to meat and poultry products. Foods mishandled in food service establishments</td>
</tr>
<tr>
<td>Enterhemorrhagic E. coli</td>
<td>3 – 7 days</td>
<td>Moderate to severe</td>
<td>Days to weeks</td>
<td>Yes</td>
<td>2</td>
<td>$10^1 – 10^2$</td>
<td>Insufficiently cooked ground beef</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>4 days to several weeks</td>
<td>Mild to severe</td>
<td>Days to weeks</td>
<td>?</td>
<td>0 to 30</td>
<td>?</td>
<td>Most severe illness occurs in unborn, newborn and immunocompromised. Associated with ready-to-eat meats and smoked fish</td>
</tr>
<tr>
<td>Salmonella typhi and paratyphi</td>
<td>7 to 28 days</td>
<td>Severe</td>
<td>Weeks to months; possible relapse</td>
<td>Yes</td>
<td>6</td>
<td>$&lt; 10^3 – 10^9$</td>
<td>Outbreaks frequently waterborne; contaminated shellfish or foods handled by carriers. Rare in N. America</td>
</tr>
<tr>
<td>Salmonella serovars</td>
<td>6 to 48 h</td>
<td>Mild to severe</td>
<td>Days to weeks</td>
<td>2 – 3; reactive arthritis</td>
<td>&lt;0.1</td>
<td>$1$ to about $10^9$</td>
<td>Commonly meat, poultry, milk, eggs but numerous other foods involved</td>
</tr>
<tr>
<td>Shigella spp.</td>
<td>1 to 7 days</td>
<td>Moderate to severe</td>
<td>Days to weeks</td>
<td>2 to 3</td>
<td>0.1</td>
<td>$10^7$ to $10^8$</td>
<td>Poor personal hygiene of infected food handlers</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>2 to 7 h</td>
<td>Mild to severe</td>
<td>&lt;1 to several</td>
<td>-</td>
<td>&lt;0.02</td>
<td>$&lt; 1$ g of toxin</td>
<td>High protein foods; foods handled</td>
</tr>
<tr>
<td>Organism/toxin</td>
<td>Incubation period</td>
<td>Disease severity</td>
<td>Duration</td>
<td>Sequelae</td>
<td>Fatality: case rate (%)</td>
<td>Toxic or infectious dose</td>
<td>Comments</td>
</tr>
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<td>------------------------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td>----------</td>
<td>----------</td>
<td>-------------------------</td>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Vibrio cholerae</em> (non-O1)</td>
<td>1 to 3 days</td>
<td>Mild to moderate</td>
<td>Days</td>
<td>-</td>
<td>&lt; 1.0</td>
<td>10^6 – 10^8</td>
<td>Associated with seafood</td>
</tr>
<tr>
<td><em>Vibrio parahaemolyticus</em></td>
<td>1 to 3 days</td>
<td>Mild, self-limiting</td>
<td>Days</td>
<td>Yes</td>
<td>&lt; 1.0</td>
<td>10^7 – 10^8</td>
<td>Most cases associated with seafood</td>
</tr>
<tr>
<td><em>Vibrio vulnificus</em></td>
<td>Median 16 h</td>
<td>Severe</td>
<td>Days to weeks</td>
<td>-</td>
<td>0 to 60</td>
<td>1 CFU for persons with elevated serum iron</td>
<td>All known cases associated with seafood, especially raw oysters. Most are male with chronic liver or blood-related disorders</td>
</tr>
<tr>
<td><em>Yersinia enterocolitica</em></td>
<td>1 to 3 days</td>
<td>Mild to moderate; self-limiting; chronic</td>
<td>Days to weeks</td>
<td>-</td>
<td></td>
<td></td>
<td>Sometimes mimics appendicitis; associated with pork, milk and milk products; carried by pigs</td>
</tr>
<tr>
<td><strong>PROTOZOA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryptosporidium parvum</td>
<td>1 to 2 weeks</td>
<td>Moderate to severe</td>
<td>4 days to 3 weeks</td>
<td>Yes</td>
<td>-</td>
<td>&lt;30 cysts</td>
<td>Water, marine fish. Possibly associated with raw milk and vegetables</td>
</tr>
<tr>
<td>Toxoplasma gondii</td>
<td>-</td>
<td>Mild to severe</td>
<td>-</td>
<td>?</td>
<td>-</td>
<td>1 cyst</td>
<td>Pork and insufficiently cooked hamburger. Causes severe neurological damage in fetuses</td>
</tr>
<tr>
<td><strong>OTHER PARASITES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anaskid nematodes</td>
<td>-</td>
<td>Mild to severe</td>
<td>-</td>
<td>?</td>
<td>-</td>
<td>1 larva</td>
<td>Marine fish</td>
</tr>
<tr>
<td>Diphyllobothrium spp.</td>
<td>-</td>
<td>Mild to moderate</td>
<td>-</td>
<td>?</td>
<td>-</td>
<td>1 larva</td>
<td>Transmitted by freshwater fish; severe illness for highly immunocompromised individuals</td>
</tr>
<tr>
<td>Taenia saginata/solium</td>
<td>-</td>
<td>Mild to severe</td>
<td>-</td>
<td>Yes</td>
<td>Signficant for T. solium neurocysticercosis</td>
<td>1 cyst</td>
<td>Beef, pork</td>
</tr>
<tr>
<td>Trichinella spiralis</td>
<td>-</td>
<td>Moderate to severe</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>1 to 500 larvae</td>
<td>Primarily from undercooked pork, game meat, bear meat and walrus meat</td>
</tr>
<tr>
<td><strong>TOXINS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paralytic shellfish poisons</td>
<td>Minutes to 6 h</td>
<td>Mild to severe</td>
<td>Several days</td>
<td>-</td>
<td>1 to 4</td>
<td>≥ 100 µg</td>
<td>Shellfish only from NE or NW coasts in US and N. America</td>
</tr>
<tr>
<td>Ciguatoxins</td>
<td>Minutes to 24 h</td>
<td>Mild to severe</td>
<td>Up to several months</td>
<td>-</td>
<td>May be as high as 13%</td>
<td>40 – 70 ng</td>
<td>Tropical fish only</td>
</tr>
<tr>
<td>Domoic acid</td>
<td>-</td>
<td>Moderate to severe</td>
<td>Hours to permanent</td>
<td>-</td>
<td>Unknown</td>
<td>≥ 60 mg</td>
<td>Amnesiac shellfish poisoning associated with mussels and</td>
</tr>
<tr>
<td>Organism/toxin</td>
<td>Incubation period</td>
<td>Disease severity</td>
<td>Duration</td>
<td>Sequelae</td>
<td>Fatality: case rate (%)</td>
<td>Toxic or infectious dose</td>
<td>Comments</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------</td>
<td>------------------</td>
<td>----------</td>
<td>----------</td>
<td>-------------------------</td>
<td>-------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Neurotoxic shellfish poison (brevetoxins)</td>
<td>-</td>
<td>-</td>
<td>Several days</td>
<td>-</td>
<td>Low</td>
<td>&gt; 80 µg</td>
<td>Shellfish in southern US states; may be associated with Red Tide</td>
</tr>
<tr>
<td>Histamine (scombroid)</td>
<td>Minutes to 6 h</td>
<td>Mild to severe</td>
<td>≤ 1 day to 2 days</td>
<td>-</td>
<td>0.01</td>
<td>≥ 50 mg histamine</td>
<td>Mainly mackerel, tuna, mahi-mahi, blue fish</td>
</tr>
</tbody>
</table>

Table 4.2. Prevalence Of Pathogens On Pork Carcasses From Provincially Inspected Abattoirs In Ontario.

<table>
<thead>
<tr>
<th>Organism</th>
<th>All samples</th>
<th>BBQ Hogs</th>
<th>Market Hogs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of samples</td>
<td>% +ve</td>
<td>No. of samples</td>
</tr>
<tr>
<td>E. coli*</td>
<td>1557</td>
<td>39.5</td>
<td>168</td>
</tr>
<tr>
<td>Verotoxigenic E. coli</td>
<td>1556</td>
<td>2.1</td>
<td>168</td>
</tr>
<tr>
<td>Salmonella</td>
<td>1540</td>
<td>4.8</td>
<td>168</td>
</tr>
<tr>
<td>Campylobacter jejuni/coli</td>
<td>1556</td>
<td>26.7</td>
<td>168</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>1556</td>
<td>10.7</td>
<td>168</td>
</tr>
</tbody>
</table>

*Generic E. coli: the prevalence of this type of E. coli on meats is not as useful an indicator of meat hygiene as the concentration (i.e. number of bacteria/gm)

Source: [http://www.aic.ca/aicf/conference/Pat_Johnson.pdf](http://www.aic.ca/aicf/conference/Pat_Johnson.pdf)

Table 4.3. Prevalence Of Pathogens On Beef Carcasses From Provincially Inspected Abattoirs In Ontario.

<table>
<thead>
<tr>
<th>Organism</th>
<th>All samples</th>
<th>Culled beef</th>
<th>Fed beef</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of samples</td>
<td>% +ve</td>
<td>No. of samples</td>
</tr>
<tr>
<td>E. coli</td>
<td>1557</td>
<td>18.6</td>
<td>189</td>
</tr>
<tr>
<td>Verotoxigenic E. coli</td>
<td>1556</td>
<td>0.3</td>
<td>189</td>
</tr>
<tr>
<td>Salmonella</td>
<td>1540</td>
<td>1.6</td>
<td>189</td>
</tr>
<tr>
<td>Campylobacter jejuni/coli</td>
<td>1556</td>
<td>1.5</td>
<td>186</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>1556</td>
<td>9.9</td>
<td>189</td>
</tr>
</tbody>
</table>

Source: [http://www.aic.ca/aicf/conference/Pat_Johnson.pdf](http://www.aic.ca/aicf/conference/Pat_Johnson.pdf)
Table 4.4. **Prevalence Of Pathogens On Chicken Carcasses From Provincially Inspected Abattoirs In Ontario.**

<table>
<thead>
<tr>
<th>Organism</th>
<th>All samples</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of samples</td>
<td>% +ve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>1480</td>
<td>99.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verotoxigenic <em>E. coli</em></td>
<td>1468</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>1480</td>
<td>31.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Campylobacter jejuni/coli</em></td>
<td>1469</td>
<td>63.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>1469</td>
<td>30.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: http://www.aic.ca/aicf/conference/Pat_Johnson.pdf

Table 4.5. **Optimal And Limiting Factors For Growth Of Common Foodborne Pathogens (adapted from (2,3))**

| Organism                          | Factors affecting growth | | | | | |
|-----------------------------------|--------------------------|---|---|---|---|
|                                   | Temperature (EC)         | pH | Water activity | | |
| _Bacillus cereus_                 | 5    | 30   | 50   | 4.4  | 7    | 9.3  | 0.93    | |
| _Campylobacter jejuni_            | 25   | 42   | 45   | 4.9  | 7    | 9.0  | ?       | |
| _Clostridium botulinum_ A & B_     | 10   | 37   | 50   | 4.8  | 7    | 8.5  | 0.95    | |
| _Clostridium botulinum_ E_         | 3    | 30   | 45   | 5    | 7    | 8.5  | 0.97    | |
| _Clostridium perfringens_          | 15   | 46   | 50   | 5    | 7    | 8.9  | 0.96    | |
| _Listeria monocytogenes_           | 0    | 37   | 44   | 4.5  | 7    | 8    | ?       | |
| _Salmonella_                       | 6    | 43   | 46   | 3.8  | 7    | 9    | 0.95    | |
| _Staphylococcus aureus_            | 7    | 37   | 48   | 4.3  | 7    | 9    | 0.83    | |
| _Vibrio cholerae_                  | 5    | 37   | 44   | 6    | 7    | 11   | 0.97    | |
| _Vibrio parahaemolyticus_          | 3    | 37   | 44   | 4.8  | 8    | 9    | 0.93    | |
| _Vibrio vulnificus_                | 8    | 37   | 43   | 5    | 8    | 10   | 0.94    | |
| _Yersinia enterocolitica_          | 3    | 30   | 43   | 4.4  | 7    | 9.6  | 0.97    |
Figure 4.1. Contributing Factors To Foodborne Illness In The United States, 1993 – 1997 (adapted from (7)).
Figure 4.2. Inter-Relatedness Of Food Safety Issues From “Farm-To-Fork”
4. Meat as a Source of Chemical and Physical Hazards

i. Veterinary drugs

(a) Antimicrobial Residues

Antimicrobial residues in meat may pose potential human health risks through direct toxicity of the residues, possible involvement in allergic reactions, and involvement in the development of antimicrobial-resistant strains of bacteria in animals and people. Antimicrobial and antiparasitic residues may occur in meat following environmental contamination (unintentional administration), feed administration for disease prevention or growth promotion, or treatment of individual sick animals. In general, illegal tissue residues occur when there is a failure to observe the recommended drug withdrawal period (time from last treatment to slaughter).

There are a number of well-developed controls in place for protection of public health and consumer confidence from antimicrobial residues in foods. Through Codex Alimentarius, the international food safety standard-setting agency, these chemicals are subject to risk assessment and establishment of safe levels in foods (see chapter 7 for further details). Nationally, Health Canada evaluates the human health safety of antimicrobials before allowing their sale for use in food animals in Canada. This evaluation includes consideration of residues in foods, and determines the safe conditions of use, and necessary meat withdrawal periods. In addition, federal and provincial authorities maintain credible testing programs for residues in meat and other foods from animals. Finally, residue avoidance is an important component of on-farm food safety programs of all commodities. The results of these controls is an exceedingly low prevalence of illegal residues in meats in Ontario and the rest of Canada (8).

Animal-derived protein may also become contaminated with antimicrobial residues if treated animals are rendered before the drug label withholding time has passed. Animals at highest risk are those that die shortly after treatment (i.e. dead stock), animals condemned at slaughter, and animals treated accidentally. An example of the latter occurred in Canada in 2000. A pig producer mistakenly fed market-ready pigs a ration containing the antimicrobial carbadox, which had a 35 day withholding period. The pigs were mistakenly sent to slaughter within this period however the producer later noticed the error and notified authorities. This resulted in the recall of pork from about 2600 hogs, and a recall of feed potentially containing protein meal contaminated with carbadox residues. In order to avoid this sort of problem in the future, carcasses of animals treated with certain antimicrobials are not accepted by Ontario renderers unless the drug withdrawal time for tissue residues had expired.

(b) Hormone Residues

Natural and synthetic hormones are often used in beef production to promote growth and increase the efficiency of feed utilization. There is however, some controversy over their use, especially in Europe where they are not permitted. The controversy began decades ago when diethylstilbestrol (DES) was banned from use as a growth promotant in cattle in the United States because clinical use of the compound in women was associated with vaginal cancer in some of their daughters. DES has never been approved for use in food animals in Canada. The controversy has continued in recent years, with the European Union ban on the use of all anabolic hormonal substances in food animals. However, North
American and international authorities consider the approved hormones to be safe when used according to approved label instructions (9, 10).

Recombinant bovine somatotropin (rBST) is a hormonal substance used in some countries to enhance milk production in dairy cattle. It is generally believed to be safe for humans, although there are reports of increased rates of lameness and other health problems in treated animals. It has never been approved for use in Canada (10).

(c) Environmental Pollutants and Pesticides

Agricultural pesticides may enter the food chain as a result of use on animals or plants. Chemicals used for non-agricultural industrial purposes can enter the food chain through accidental contamination of animal feeds, water or the environment. Historically, of most concern to meat safety are those chemicals that accumulate in animal or fish tissues, and most of these have been banned or are formed unintentionally though industrial activities. Some metallic contaminants may be used for medicinal purposes in animals (such as compounds containing arsenic used for growth promotion and to treat parasites in poultry and swine). Lead, mercury and cadmium are toxic natural elements with no known physiological functions but which have been introduced in more concentrated form into the human food chain as the result of human industrial activities (11).

Dioxins are a group of chemical pollutants that have entered the environment and therefore the food chain from incineration plants, high-temperature industrial processes, the pulp and paper industry, and traffic exhausts. Dioxins are of special concern because they tend to accumulate in fatty tissues and therefore bioaccumulate up the food chain. They have also been implicated in some feed contamination incidents, the largest recently occurred in Europe. Another recent high-profile controversy concerns dioxin residues in farmed salmon. These contaminants are believed to originate from the fish-derived feed used in salmon production. These compounds are heat-stable and are therefore not inactivated by cooking or other processes (11).

(d) Food Additives and Processing-Related Contaminants

Food additives are compounds that may be added to foods in order to preserve nutrient value, enhance keeping qualities, improve appearance and flavour, and aid processing. Examples include flavours, sweeteners, antioxidants, thickeners, emulsifiers, and acidulants. Sodium nitrite is an additive of particular relevance to the safety of cured meats (e.g. ham, bacon). Nitrite contributes to the stable pink colour and characteristic flavour of these products, but importantly, nitrite has significant antibacterial properties and is particularly effective in preventing growth of *Clostridium botulinum*, the causative agent of botulism. Nitrite use is, however, somewhat controversial because under certain conditions, it may combine with amines in meat to form carcinogenic N-nitroso compounds (nitrosamines). Limiting the quantities of nitrite used can minimize nitrosamine formation.

(e) Physical Hazards

Physical hazards in meats include broken needles from faulty injection of animals, metal or glass fragments from meat processing, and bone chips from slaughter and processing. Most of these hazards occur rarely in foods and do not pose important public health risks, which are limited mainly to potential for damage to teeth when chewing. Their importance lies mainly with consumer confidence. Control at
the farm level includes education of producers in proper injection techniques and corrective strategies (e.g. surgery) when needles are broken. At processing, many industries use metal detectors.

5. Importance of Non-Biological Contaminants

While rare incidents of human disease have been attributed to hazardous levels of these contaminants in milk and meat, residues of chemical contaminants in meats are rarely detected at more than trace levels and consequently are not of major public health concern. Nevertheless, non-biological contaminants continue to be very important with respect to international trade and consumer confidence, and efforts to reduce the incidence of occurrence in foods is warranted. Furthermore, continued monitoring and periodic reassessment of risks posed by these contaminants is needed to detect or anticipate new problems so that appropriate action can be taken.

II. TRENDS IN REPORTED FOODBORNE ILLNESS IN ONTARIO

Lee and Middleton recently reviewed and summarized Ontario surveillance data on sporadic cases of enteric illness in Ontario 1997-2001 (12). Sporadic cases are those not associated with known outbreaks. There were 44,451 reported cases of eight enteric illnesses (Tables 4.6-4.8). Males and females were approximately equally represented, and rates of illness were highest in the 1-4 years of age group. Rates of *Campylobacter* infection increased in the 20-29 age group, and *Listeria* rates were greatest for people in the 70+ age group. Loose diarrhea and watery diarrhea were the most frequently reported symptoms for *Campylobacter*, *Salmonella*, *Yersinia*, verotoxin-producing *E. coli* (VTEC; *E. coli* O157:H7 is a member of this group) and *Shigella*. Jaundice was the most frequent symptom among hepatitis A victims, and fever was most common among *Listeria* infected patients.

One hundred and thirteen deaths were reported during the 5-year period, although in 35 of these deaths, the pathogen was reported as an incidental finding. The highest case-fatality rate was for *Listeria* infection.

Food was considered (in some cases assumed to be) the source of infection in 74% of cases, followed by person-to-person spread in 6%, and animal contact in 5.8%. A specific suspect food type was named in only 21% of these cases. Among these, chicken was the reported vehicle in 42.1% of cases. Beef was mentioned in most cases of VTEC infection and pork in *Yersinia* infection.

Among risk settings, “home” was mentioned most frequently (50.2%), followed by international travel (24.6%), which was the most frequently reported setting for *Shigella* and Hepatitis A infections. *Campylobacter*, *Salmonella* and VTEC had pronounced seasonal patterns, with increased incidence in the summer months (June-September). There was some indication that the number of cases had declined over time; the number of cases for the 1997-2001 period was less than the 1992-1996 period.

Reported outbreaks of enteric illness in Ontario 2000-2002 using the RDIS outbreak model were recently reviewed by Lim and Middleton (13). Outbreaks were defined as two or more enteric illnesses associated by time, exposure and / or place. There were 1,580 outbreaks reported during the study period, affecting 56,774 people, for an average of 36 affected people/outbreak. Sixty-two per cent occurred during the winter (December-March) and 62% were reported in health care institutions. Person to person transmission was reported in 65% of outbreaks and there were lesser proportions of foodborne,
waterborne and other routes of transmission. Etiologies (microbiological causes) were reported in 772 outbreaks, 416 of which were viral, 125 bacterial and the rest other causes.

It should be noted that many of these reported cases were believed to be imported, i.e. acquired while travelling abroad. It should also be acknowledged that the present surveillance system generally does not distinguish between food sources that are provincially inspected from those that are federally inspected. It is also very difficult in many instances to distinguish infections of meat origin from other origins. Furthermore, it is well known that foodborne disease surveillance systems that are based on reported cases and outbreaks usually underestimate the incidence of disease (14). This due to a variety of factors and the biases produced vary with disease. Finally, it is often very difficult for inspectors to determine the sources of infection. Sometimes these determinations are based on laboratory testing, epidemiological investigation, or interviews of affected individuals.

When reviewing foodborne disease surveillance data it is important to remember that foodborne diseases are inherently multifactorial in origin, that is, they have multiple contributing factors. While a proximal cause may be identified by an inspector following up on a case or during outbreak investigation (e.g. faulty cooking in the home or foodservice) there are invariably other “causal factors” or risk factors as epidemiologists call them, which contribute to the case or outbreak. For example, a raw meat ingredient for a food implicated in an outbreak may have contained low concentrations of a pathogenic organism, such as \textit{Salmonella}, as a result of contamination at slaughter. If the raw ingredient had not contained the \textit{Salmonella}, there may not have been an outbreak, even if the food was cooked improperly. Conversely, if the food had been cooked properly, there may have been no outbreak, even if the raw meat was contaminated. Beyond that, if the live animals had not been carriers of \textit{Salmonella}, the raw meat might not have been contaminated at slaughter, and so on. There are a lot of “ifs” and “maybes” in this sort of scenario, but repeated often enough, and if sufficient safeguards are not in place, the law of averages determine that things will eventually go wrong with a sufficient number of factors and outbreaks will occur.

As discussed in other chapters, there is a need for improved surveillance to act as an early warning system to more quickly and efficiently identify outbreaks so that controls can be quickly implemented. Examples of improvements to surveillance include improved laboratory techniques for rapid identification of disease clusters related to certain strains of pathogens (e.g. use of PFGE patterns of \textit{E. coli} O157:H7 in the PulseNet program), and improved techniques for identifying animal species of origin for certain strains of pathogens. These improvements would also provide better information for risk assessment to help guide public health policy. For example, in an ideal food safety system, high quality foodborne disease surveillance would help to define public health objectives, determine where use of available resources would do the most good, and provide benchmarks against which progress in control efforts throughout the farm-to-fork continuum could be measured. This information is helpful for risk analysis (see chapter 7).

Good foodborne disease surveillance should also be linked to hazard surveillance in foods, food animals and the food animal environment. These types of surveillance are conducted by OMAF, the Animal Health and Food Laboratories at the University of Guelph, and by some animal industries in Ontario. When integrated and reviewed on a regular basis, this information can provide useful insights into the sources and pathways of pathogens in the foodchain. For example, much useful information has
been obtained about the flow of *Salmonella* through the food chain by monitoring the animal and poultry industries (e.g. feeds and feed ingredients), the animal environment (e.g. “fluff” testing from hatcheries), and by use of baseline studies of pathogens on carcasses at slaughter. Other potentially useful sources include animal disease diagnostic laboratories, and food and agriculture laboratories, and some private laboratories. Barriers to be overcome in making timely use of this information include the availability of people and facilities dedicated to the task, greater access to proprietary information while protecting legitimate privacy concerns, willingness of various parties to contribute data and make summary results public, and sufficient incentives to participate.


<table>
<thead>
<tr>
<th>Mode of transmission</th>
<th>Campylobacter %</th>
<th>Salmonella %</th>
<th>VTEC %</th>
<th>Yersinia %</th>
<th>Shigella %</th>
<th>Hepatitis A %</th>
<th>Listeria %</th>
<th>Total cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>75.9</td>
<td>80.1</td>
<td>59.9</td>
<td>75</td>
<td>47.1</td>
<td>36.1</td>
<td>31.6</td>
<td>74.0 14,580</td>
</tr>
<tr>
<td>Water</td>
<td>6.6</td>
<td>3.2</td>
<td>21.5</td>
<td>5.5</td>
<td>19.9</td>
<td>12.9</td>
<td>2.6</td>
<td>7.0 1,382</td>
</tr>
<tr>
<td>Person-person</td>
<td>3.0</td>
<td>6.3</td>
<td>8.8</td>
<td>6.7</td>
<td>23.8</td>
<td>31.7</td>
<td>10.5</td>
<td>6.0 1,186</td>
</tr>
<tr>
<td>Animal contact</td>
<td>7.6</td>
<td>4.3</td>
<td>5.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.8 1,133</td>
</tr>
<tr>
<td>Sexual</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8.4</td>
<td>0</td>
<td>0</td>
<td>0.2 46</td>
</tr>
<tr>
<td>Other</td>
<td>7.0</td>
<td>6.1</td>
<td>4.0</td>
<td>12.8</td>
<td>9.1</td>
<td>10.9</td>
<td>55.3</td>
<td>7.0 1,386</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100 19,713</td>
</tr>
</tbody>
</table>

Source: Lee and Middleton (12)

Table 4.7. Food Items Associated With Foodborne Illness In Ontario, 1997 – 2001 (12).

<table>
<thead>
<tr>
<th>Food</th>
<th>% of cases</th>
<th>Campylobacter</th>
<th>Salmonella</th>
<th>VTEC</th>
<th>Yersinia</th>
<th>Shigella</th>
<th>Hepatitis A</th>
<th>Listeria</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>9.9</td>
<td>9.0</td>
<td>8.0</td>
<td>52.2</td>
<td>4.3</td>
<td>2.9</td>
<td>0</td>
<td>0</td>
<td>11.4</td>
</tr>
<tr>
<td>Pork</td>
<td>3.9</td>
<td>4.5</td>
<td>4.5</td>
<td>12.9</td>
<td>72.7</td>
<td>64.7</td>
<td>0</td>
<td>0</td>
<td>6.8</td>
</tr>
<tr>
<td>Meat</td>
<td>7.8</td>
<td>2.5</td>
<td>2.5</td>
<td>8.5</td>
<td>7.6</td>
<td>11.8</td>
<td>0</td>
<td>0</td>
<td>5.6</td>
</tr>
<tr>
<td>Chicken</td>
<td>54.9</td>
<td>37.3</td>
<td>10.9</td>
<td>7.6</td>
<td>8.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>42.1</td>
</tr>
<tr>
<td>Other poultry</td>
<td>5.7</td>
<td>4.5</td>
<td>4.5</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.5</td>
</tr>
<tr>
<td>Eggs</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>3.5</td>
<td>4.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.3</td>
</tr>
<tr>
<td>Raw milk</td>
<td>6.9</td>
<td>1.6</td>
<td>1.6</td>
<td>3.5</td>
<td>4.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.3</td>
</tr>
<tr>
<td>Cheese</td>
<td>0.7</td>
<td>22.0</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>87.5</td>
</tr>
<tr>
<td>Fish</td>
<td>1.7</td>
<td>2.1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
<td>2.9</td>
<td>0</td>
<td>0</td>
<td>1.8</td>
</tr>
<tr>
<td>Shellfish</td>
<td>0.1</td>
<td>0.3</td>
<td>1.0</td>
<td>0</td>
<td>5.9</td>
<td>97.4</td>
<td>0</td>
<td>0</td>
<td>2.8</td>
</tr>
<tr>
<td>Cider</td>
<td>0</td>
<td>0.1</td>
<td>4.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>Other</td>
<td>6.7</td>
<td>6.7</td>
<td>2.5</td>
<td>0</td>
<td>2.9</td>
<td>2.6</td>
<td>12.5</td>
<td>6.2</td>
<td></td>
</tr>
</tbody>
</table>

Source: Lee and Middleton (12)
Table 4.8. Mode Of Acquisition Of Illness Associated With Enteric Pathogens In Ontario, 1997 – 2001 (12)

<table>
<thead>
<tr>
<th>Setting</th>
<th>% of cases</th>
<th>Campylobacter</th>
<th>Salmonella</th>
<th>VTEC</th>
<th>Yersinia</th>
<th>Shigella</th>
<th>Hepatitis A</th>
<th>Listeria</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>51.0</td>
<td>50.4</td>
<td>66.4</td>
<td>67.3</td>
<td>19.2</td>
<td>27.8</td>
<td>70.7</td>
<td>50.2</td>
<td></td>
</tr>
<tr>
<td>Travel</td>
<td>21.8</td>
<td>25.4</td>
<td>7.6</td>
<td>13.0</td>
<td>68.5</td>
<td>49.3</td>
<td>4.3</td>
<td>24.6</td>
<td></td>
</tr>
<tr>
<td>Restaurant</td>
<td>16.0</td>
<td>14.0</td>
<td>12.6</td>
<td>8.1</td>
<td>3.6</td>
<td>6.2</td>
<td>2.2</td>
<td>14.1</td>
<td></td>
</tr>
<tr>
<td>Workplace</td>
<td>5.5</td>
<td>3.8</td>
<td>2.6</td>
<td>3.1</td>
<td>2.5</td>
<td>1.5</td>
<td>0</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Institution</td>
<td>2.2</td>
<td>4.5</td>
<td>5.3</td>
<td>5.6</td>
<td>2.3</td>
<td>5.5</td>
<td>22.8</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>3.4</td>
<td>1.8</td>
<td>5.5</td>
<td>2.8</td>
<td>3.8</td>
<td>9.9</td>
<td>0</td>
<td>3.2</td>
<td></td>
</tr>
</tbody>
</table>

References and Bibliography

CHAPTER 5

FOOD SAFETY LABORATORY SUPPORT AND FOODBORNE DISEASE SURVEILLANCE

Laboratory and surveillance support is critical for the proper functioning of a modern meat inspection system. Analytical testing, scientific advice and research provide the foundation for food safety programs. In recent years, there has been an exponential growth in the demand for testing to support foodborne monitoring and quality assurance programs as a result of increased public awareness, globalization, and terrorism. In addition, we have seen an unparalleled technological evolution, which has increased the ability to detect chemical and microbiological contaminants to new levels. The complexity of analytical testing has also evolved rapidly, and we now have more than five times the number of foodborne pathogens than recognized 50 years ago. Rapid and sophisticated food distribution systems require that laboratory results be distributed quickly in order to allow for timely intervention. All of these factors have combined to place enormous economic and human resource demands on laboratories and surveillance systems.

This chapter seeks to describe the current foodborne disease laboratory, quality assurance and surveillance programs that provide support for the Ontario meat inspection system.

I. LABORATORY SUPPORT

Roles and Responsibilities.

Laboratory support for the meat system in Ontario is complex. Conceptually, the system can be broken into three components; on farm, in plant, and retail. It is important to realize that the scientific support for the system has to be integrated and interactive across all three of these components for the system to operate in a safe, efficient and secure manner.

1. On Farm

The Canadian Food Inspection Agency (CFIA) laboratories are responsible under the Health of Animals Act for the detection, research, and scientific advice for diseases exotic to Canada and some indigenous diseases that are of national economic or public health significance. This system has laboratories at 16 sites across Canada, including a level four containment laboratory in Winnipeg and a number of level three laboratories in Lethbridge, Saskatoon, Ottawa, St. Hyacinthe, and Charlottetown.

The majority of the laboratory support for animal health in Ontario is provided by the Animal Health Laboratory, Laboratory Services Division, University of Guelph. This laboratory system (previously part of OMAF) has a long history as one of the top provincial veterinary diagnostic laboratories in Canada. This capability, coupled with co-location of the main laboratory with the Ontario Veterinary College creates a synergistic relationship for scientific excellence, training, and extension. A small regional laboratory in Kemptville provides additional necropsy and extension services. During the cutbacks of the 1990s, a number of provincial veterinary laboratories were closed. These included laboratories in New Liskeard, Huron Park, Brighton, and Ridgetown. The concentration of activities in
Guelph has been beneficial in some management aspects, however, the loss of “eyes and ears” in various locations around the province has weakened the capability for detection of exotic diseases and emerging pathogens.

2. In Plant

Laboratory support for meat inspection in federally inspected establishments is the responsibility of the CFIA. Eight CFIA laboratories located in Burnaby, Calgary, Saskatoon, Scarborough, Ottawa, St. Hyacinthe, Longueil, and Dartmouth provide support to meat and fish inspection activities. The majority of analytic activity is in support of national sampling plans for monitoring the federally inspected food supply, investigation of consumer complaints, disease outbreaks and emerging food safety issues. Support is also provided on request to provincial programs.

Laboratory activities in support of the provincial meat inspection program of the Food Inspection Branch are described in the Meat Inspection Policy and Procedures Manual, revised January 4, 2002. Analytical testing is primarily provided by the Regulatory and Analytical units of the Laboratory Services Division, University of Guelph, with support from the Animal Health laboratories, University of Guelph and Maxxam Analytics, Inc. and the CFIA laboratory system. Analytical testing activities fall under three categories, surveillance, monitoring, and baseline studies and pathogen monitoring projects.

3. Retail

Inspectors in the Health Units are primarily responsible for sampling at this level in support of their food safety programs. Table 5.1 contains information from Toronto Public Health on the varied responsibilities of inspectors which is typical for most of the health units.

Table 5.1. Toronto Public Health – Healthy Environments Service. Major Responsibilities of Public Health Inspectors

<table>
<thead>
<tr>
<th>Category</th>
<th>Legal Requirements</th>
<th>Major Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOD</td>
<td>Provincially mandated</td>
<td>(a) Determining the risk status (high, medium or low) of all food premises according to the Ministry of Health Hazard Analysis Critical Control Point Protocol (1998); (b) Providing all high, medium and low-risk food premises not less than three, two, and one compliance inspection per year respectively plus an annual food audit to high-risk premises; (c) Providing additional inspections and re-inspections to all food premises as necessary; (d) Responding to food-related complaints within 24 hours of notification; (e) Ensuring the availability of certified food safety training courses to food handlers in high or medium risk food premises; (f) Food premises food poisoning investigation.</td>
</tr>
<tr>
<td>Category</td>
<td>Legal Requirements</td>
<td>Major Responsibilities</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Municipally</td>
<td>(a) Approving license and property purchase applications for food premises;</td>
<td>(a) Approving license and property purchase applications for food premises;</td>
</tr>
<tr>
<td>required</td>
<td>(b) Approving special event/occasion applications;</td>
<td>(b) Approving special event/occasion applications;</td>
</tr>
<tr>
<td></td>
<td>(c) Examining plan applications;</td>
<td>(c) Examining plan applications;</td>
</tr>
<tr>
<td></td>
<td>(d) Pre-licensing inspection of hotdog carts, ice cream trucks, catering trucks</td>
<td>(d) Pre-licensing inspection of hotdog carts, ice cream trucks, catering trucks</td>
</tr>
<tr>
<td></td>
<td>(e) Enforcing the City’s No-smoking By-law for food premises;</td>
<td>(e) Enforcing the City’s No-smoking By-law for food premises;</td>
</tr>
<tr>
<td></td>
<td>(f) Foodborne outbreak responses.</td>
<td>(f) Foodborne outbreak responses.</td>
</tr>
</tbody>
</table>

Source: Comprehensive Food Safety Report and Food Premises Disclosure System, Dr. Sheela Basrur, Medical Officer of Health, June 19, 2000

In general the laboratory submissions from these activities could be characterized as follows:

**Illness and Outbreak Investigations.** Sampling involves swabs from contaminated surfaces, food samples and other appropriate samples as deemed by the inspector during the investigation. Results from laboratory submissions are matched with clinical samples from affected human subjects during the investigation to provide epidemiological links.

**Audits of foods in high-risk food premises.** Environmental and food samples are collected on the basis of a risk assessment process that would prioritize high-risk premises, assessed on a variety of factors such as volume and, complexity, etc.

**Special Surveys.** These investigations are done on request from the Ministry targeting specific products or premises as part of larger studies performed across the province.

**Seizures.** On occasion, inspectors will seize and hold product if there is deemed to be a health hazard to the public. In these situations, the samples may be taken to confirm the risk to public.

**Species verification,** in some cases, inspectors must determine if meat products are from the species identified on the label. Occasionally exotic meats can be seized and tests are required to verify species of origin.

II. LABORATORY ACCREDITATION

Quality assurance is demanded by consumers at all levels of the food production system, especially the laboratories that provide analytical testing in support of these programs. There are a variety of standards and organizations that provide certification. One of the most important is the Standard Council of Canada which is responsible for managing Canada’s participation in the International Organization for Standardization (ISO). The standard used for general requirements for competence of testing and calibration of laboratories is CAN-P-4D (ISO/IEC 17025:1999). Recently, a new document, describing enhanced requirements for accreditation of agriculture and food products laboratories, has been released (CAN-P-1587 March 2003). Quality systems require that laboratories maintain proper documentation and manuals, have periodic comprehensive on-site assessments, proficiency testing, and responses to surveillance questionnaires.
The accreditation status of laboratories serving Ontario is as follows:

1. The entire CFIA laboratory system has been accredited by the Standard Council of Canada to ISO/IEC guide 25.

2. The Laboratories Services Division of the University of Guelph achieved ISO 9001: 2000 accreditation for the scope: development and provision of analytical and diagnostic laboratories services in the area of food quality and safety, agricultural, environment analysis and animal health. Accreditation has also been received from the American Association of Veterinary Laboratory Diagnosticians and the Food and Drug Administration-Center for Food Safety.

3. Maxxam Analytics Laboratories are accredited by the Standards Council of Canada for Food Analysis.

4. The Ministry of Health laboratories are not accredited for food testing. All Public Health laboratories will be accredited for water testing within the next six months. They then plan to proceed with accreditation for food bacteriology.

III. PROVINCIAL TESTING PROGRAMS

The Meat Inspection Program of the Food Inspection Branch, OMAF conducts a variety of testing programs for foodborne hazard surveillance. The testing protocols (over 50) are summarized in the meat inspection policy and procedure manual section 08.02. These projects represent a comprehensive matrix of sampling plans to support the program, and target, among others, antimicrobial residues, pesticides, heavy metals, microbiological hazards, trichina, anabolic hormones, water and ice microbiological quality, histopathology of meat inspection specimens, parasitology, and BSE surveillance testing.
1. Meat Testing

Table 5.2 is a recent summary of analytical tests performed in support of the Provincial Meat Inspection Program

Table 5.2. Tests Conducted on Meat Samples 2001-2004

<table>
<thead>
<tr>
<th>TEST PROGRAM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Histology/Parasitology</td>
<td>755</td>
</tr>
<tr>
<td>Antibiotic Residue Monitoring</td>
<td>5,927</td>
</tr>
<tr>
<td>Rabbit Antibiotic Residue Surveillance</td>
<td>87</td>
</tr>
<tr>
<td>Antibiotic Residue Suspect Testing</td>
<td>8,346</td>
</tr>
<tr>
<td>Drug confirmation</td>
<td>159</td>
</tr>
<tr>
<td>Sulfa testing - Market Hogs/Sows</td>
<td>280</td>
</tr>
<tr>
<td>Sulfa testing - BBQ Pigs/ Wild Boars</td>
<td>18,390</td>
</tr>
<tr>
<td>Drug Confirmation</td>
<td>672</td>
</tr>
<tr>
<td>Trichina Monitoring - Sows/Boars</td>
<td>731</td>
</tr>
<tr>
<td>Trichina Monitoring - Wild Boars</td>
<td>228</td>
</tr>
<tr>
<td>Pollutants/Pesticides</td>
<td>-</td>
</tr>
<tr>
<td>Beta Agonists (Investigation)</td>
<td>125</td>
</tr>
<tr>
<td>Pathogen Screen</td>
<td>3</td>
</tr>
<tr>
<td>Carbadox Testing</td>
<td>1,398</td>
</tr>
<tr>
<td>BSE Testing</td>
<td>2,470</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41,082</strong></td>
</tr>
</tbody>
</table>

In addition, in 2003-2004 (first three quarters) there were 1611 microbial profiles conducted on beef samples.

2. Water Testing

Water testing has been conducted at Laboratory Services Division (LSD) since September 2003. Prior to that, laboratory testing was conducted at the 12 Public Health Laboratories across the province. Results in a rolled up format are only available since May of 2002. The meat inspection program has been entering these hard copy results into the Food Safety Decision-Support System (FSDSS), but has not completed data entry prior to May of 2002. Since September 2003, all water results are automatically entered electronically through the laboratory interface. Numbers of samples tested during the period Jan 2002- Jan 2004 range from 345 to 508 per month. In addition in the year 2003-2004 (first three quarters) there were 116 tests performed for *E. coli* O157:H7 in water samples that had positive results for generic *E. coli*.

3. Microbiological Baseline Studies

The Ministry has undertaken an ambitious program to conduct meat baseline studies of targeted microbial pathogens, indicator organisms, and/or studies of chemical and biological contaminants across the domestic food animal population in Ontario (these are further discussed in chapters 4&7). Studies have been completed on hogs (1999-2000), beef (2000-2001), and chickens (2001-2002). Studies
concerning chemicals in raw meat and ready-to-eat meats are currently underway. These studies have required the processing of thousands of samples for a wide variety of testing regimes.

Table 5.3. Meat Baseline Studies Conducted By OMAF

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of samples</th>
<th>Number of tests</th>
<th>Year study conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pork carcasses</td>
<td>1557</td>
<td>10899</td>
<td>1999-2000</td>
</tr>
<tr>
<td>Beef carcasses</td>
<td>1459</td>
<td>10213</td>
<td>2000-2001</td>
</tr>
<tr>
<td>Post-chill Chicken carcasses</td>
<td>1480</td>
<td>13320</td>
<td>2001-2002</td>
</tr>
</tbody>
</table>

4. Chemical Residue Baseline Studies

Currently, two parts of a three-phase baseline study of chemical contaminants in meat have been completed and are being analyzed. The table below gives details on the types of samples taken. A preliminary report is expected by April 2004.

Table 5.4. Samples Taken In Meat Baseline Studies Of Chemical Residues In Meat Conducted By OMAF

<table>
<thead>
<tr>
<th>Phase I</th>
<th>Number of samples</th>
<th>Total number of tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1300 muscle</td>
<td>13,220</td>
</tr>
<tr>
<td></td>
<td>300 thyroid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>120 fat</td>
<td></td>
</tr>
<tr>
<td>Phase II</td>
<td>1300 muscle</td>
<td>15,958</td>
</tr>
<tr>
<td></td>
<td>300 thyroid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>480 fat</td>
<td></td>
</tr>
</tbody>
</table>

IV. MINISTRY OF HEALTH PROGRAMS

Any of the 37 Health Units can submit samples to the 12 Public Health Laboratories located in London, Windsor, Hamilton, Toronto, Orillia, Peterborough, Kingston, Ottawa, Timmins, Sault Ste. Marie, Sudbury and Thunder Bay. Food samples are forwarded to the three sites that perform food testing: Toronto, Windsor and Timmins. Volumes of food samples based on the last fiscal year were: Toronto (3,628), Timmins (440) and Windsor (632).
V. QUALITY ASSURANCE/QUALITY CONTROL PROGRAMS

Food quality is an intrinsic property of food which can be defined in a number of ways. It generally is defined by a standard for a specific commodity or usage. However, it is useful to consider the determinants of quality which include nutritional properties, hygienic properties, functional properties, and organoleptic properties (appearance and palatability). In a sense, food safety could be considered part of food quality under the hygienic properties because it would serve to protect these properties in the production of hazard reduced or free food. Quality assurance is a broad view of application of quality standards to the production, processing, and marketing sectors with emphasis on prevention of problems. It is generally applied throughout the process and is a good tool for problem solving. A good quality assurance program is the foundation for a strong food safety program. On the other hand quality control focuses more on examination and inspection rather than prevention. It is difficult to inspect quality into products and cure problems after they occur. It is easier to focus on prevention and risk reduction.

A comprehensive quality assurance approach, therefore, includes the whole production and distribution system, from suppliers of raw materials through the processing, distributing, and retailing to the consumer. The focus of quality assurance is prevention and this should mean that action is taken to meet a specification and prevent failures from occurring a second time. This is done by planning, risk management, and agreements with key suppliers and other sectors in the food continuum.

Quality assurance functions are executed with assistance of a quality assurance laboratory where analyses are performed and data are collected to support the validation and verification of food safety programs, to support process control and improvement, and to support product improvement and development. The data collected are also used to monitor raw materials, processes, and finished products to make sure customer guidelines and specifications as well as government regulations are being met.

The size of the quality assurance laboratory and how it interacts with the other functions of the operation will depend on the size of the company and the operation. Large corporations will have elaborate quality assurance programs with the appropriate supporting laboratories, while smaller companies may have small labs or use the services of external contract laboratories. The organization of the laboratory will depend on the type of processing facility it supports. An establishment which produces a variety of products including ready-to-eat products will have a more comprehensive program than a simple operation which slaughters and produces only fresh meat products.

The larger laboratories will be organized to collect a variety of samples and perform a number of analyses. The larger labs will also have the capability to conduct the more sophisticated analyses. Depending on the size and type of operation, the lab may be organized into sections. An example is the chemical section which will evaluate raw material composition (e.g. protein, fat, moisture), veterinary drug residues, additives or other ingredients which have been added to the meat products, such as salt, phosphates, sodium nitrate and nitrite, and final production composition, when necessary. Another example is the microbiological section, which would sample and analyze raw materials, non-meat ingredients, finished products, and environmental samples for quantitative testing of a variety of indicator or surrogate microbes, such as aerobic plate count, total coliforms, generic E. coli, and Enterobacteriaceae. Sometimes qualitative tests are also conducted for monitoring of pathogens, such as Salmonella, E. coli O157:H7, and Listeria. The microbiological section is particularly important in...
supporting the HACCP-based food safety system because of its monitoring function for the quality and safety of raw materials, validation of interventions and other process controls, and monitoring of sanitation and hygiene programs. A third section would be responsible for sensory evaluation which would evaluate products for acceptable palatability and appearance, and support the development of new products.

It is important to mention that small and very small establishments, and perhaps even medium size operations, would not have as an elaborate system as discussed above. However, some quality assurance with a sample and data collection system is necessary to support even the most modest food safety and quality program. The important principle is to organize a cost-effective quality assurance program to support an effective food safety system. While a laboratory on the premises may not be necessary, it would be useful in many circumstances where distances may be an impediment to obtaining time sensitive results, e.g. microbiological results. There are commercial laboratories which can be used, but the cost of having someone else do the testing has to be weighed against the competence and cost of doing it yourself. Not to be overlooked is assistance from ingredient suppliers in performing some analyses. Also, the government could help by testing water, and monitoring antimicrobial and other residues.

A quality assurance program is crucial to a successful HACCP-based food safety program. The main functions are to 1.) support monitoring which is the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a critical control point (CCP) is under control; 2.) support validation which is the confirmation that the elements of the HACCP system are complete and effective in controlling biological, chemical, and physical hazards. This may include ingredient and product sampling and testing; and 3.) it supports verification which is the application of methods, procedures, tests, and other evaluations, in addition to the monitoring to determine conformance and effectiveness of the HACCP-based food safety system.

Training is an essential element in establishing a quality assurance system. Not only understanding the elements of the program, but how to use it effectively in the context of the food safety program is important. These factors should be considered in the design of an individual program and illustrated through the use of models. The system need not be elaborate to be effective, but cost effective and supportive for the size of establishment where it will be used.

VI. REPORTING SYSTEMS

1. Meat Inspection Program, Food Inspection Branch.

All submission of laboratory samples is done using electronic forms as part of The Food Safety Decision-Support System (FSDSS). Inspectors upload submissions daily to the server specifying the identity of sample and the type of analysis required. Sample information is uploaded to The Laboratories Information Management System and is available by the time the sample arrives. A detailed instruction guide can be found in meat inspection policy and procedures manual section 08.03. Maxxam Analytics system has an electronic submission system for food clients called FoodLINK.

When results are approved by Laboratory Services Division (LSD) and Animal Health Laboratory (AHL) staff they are reported electronically and can be accessed in a real-time manner.
Results from Maxxam are also received electronically however there is no real-time access currently available.

Various OMAF staff receive the laboratory results in different ways. All results require review by professional staff to determine appropriate actions to be taken. Veterinary scientists receive the data in an electronic form through the FSDSS. The results can be queried with respect to project, time period, etc. Residue control officers extract results using a database reporting tool called Crystal Reports. Using templates designed by trained FSDSS staff, they can set parameters and filters to extract, display, and print any relevant results. Water results are reviewed by the Water Safety Control Officer, who reports them to appropriate parties and arranges for appropriate action to be taken. Results of baseline studies and monitoring programs are reviewed by a food scientist and/or a veterinary scientist.

All results reporting is essentially “real-time”, as the data populate the FSDSS database shortly after the result has been approved (the interface runs every ½ hour 8-10 am, every ¼ hour 10-12, and every hour in the afternoon). Thus, held product can be released or suspicious results investigated in a timely manner.

2. Health Units, Ontario Ministry of Health and Long-Term Care

Food samples are submitted with paper forms and results are received from laboratories in a paper format. At present, there is no electronic system to send results of food samples to the inspector. If the lab finds significant levels of bacteria that cause food poisoning, the Health Unit is contacted by phone. Negative results are returned by mail or interoffice couriers. Health Units can request Fax of any results if they need a copy immediately. When outbreaks occur, a "line listing" of all results (clinical and environmental) is produced if circumstances require a daily summary of results.

There is currently electronic reporting of private water samples. It is hoped that in the near future food testing results will also be available electronically. Annual reports of morbidity and mortality are prepared by the Ministry. If an inspector believes that there is a suspicious occurrence, or perhaps the start of an outbreak, this information can be posted on a secure Health Canada web site. There is also a national enteric surveillance system that provides information to inspection staff from Health Canada. Inspectors also utilize the CFIA email notification systems for recalls, and incidents in the national food system.

Health inspectors utilize an interpretation guide for laboratory results published by the Laboratories of the Ministry of Health and Long-Term Care. This guide is called “The Health Inspectors Guide to Principles and Practices of Environmental Microbiology”, published in 1997.

The difficulties experienced by public health inspectors were illustrated by the following excerpt from the Toronto Public Health report: Comprehensive Food Safety Report and Food Premises Disclosure System, Dr. Sheela Basrur, Medical Officer of Health, June 19, 2000.

“The ten different information systems currently used within Healthy Environments Services cannot be linked centrally. Each of the former municipalities’ information system(s) (note: some municipalities use more than one system) differs slightly from others in terms of the type of data and reports that are routinely collected and generated. To date, the lack of a single and adequate information system has been, and continues to be, a major obstacle in the day-to-day and long-term management of the Food Safety Program. For example, retrieval of City-wide data has to be done separately from each
site office (except in South Region), comparability of performance indicators is questionable, and some regions have limited capacity to perform cost analysis of specific program components and activities. This has caused serious delays and difficulties in the retrieval and analysis of inspection and food premises data across the City.”

Much progress has been made since this was written and a number of new systems have been initiated to improve the linkages between data bases and reporting units. The following describes some of the systems currently available.

i. Reportable Diseases

The Health Protection and Promotion Act (HPPA) requires all practitioners under the Regulated Health Professions Act as well as hospital administrators, superintendents of institutions, school principals and operators of laboratories, to notify the Medical Officer of Health when a “person has or may have a reportable disease”. Ontario Regulation 559/91 as amended under the HPPA specifies the reportable communicable diseases. This list includes common foodborne pathogens including Campylobacter, Salmonella and Verotoxin producing E coli infections such as E. coli O157:H7. In addition, the regulation lists as reportable diseases, food poisonings of all causes.

ii. Reportable Disease Information System

All Ontario Health Units utilize the Reportable Disease Information System (RDIS) for tracking reportable communicable diseases. Each of the 37 Ontario Health Units must report all confirmed cases of disease to the Public Health Division of the Ontario Ministry of Health and Long-Term Care. This is done on a weekly basis. This provincial surveillance system was developed in the 1980’s and is based upon a proprietary architecture that is no longer widely used or supported. Other significant operational issues related to RDIS include: no standard training instruments and the inability to share case management information among clinical practitioners. Because of the serious deficiencies in this outdated system, all time critical surveillance reports of communicable diseases are provided to the Ministry of Health and Long-Term Care through telephone calls, emails, letters, faxes etc. These forms of communication create their own difficulties in ensuring completeness, confidentiality and accuracy. The RDIS deficiencies were highlighted during the recent SARS outbreak and the need for a comprehensive, standardized, flexible information technology system at both the provincial and national levels was highlighted both by the National Advisory Committee on SARS and Public Health and the Ontario Expert Panel on SARS and Infectious Disease Control (see chapter 9).

iii. Canadian Enteric Outbreak Surveillance Centre

The Canadian Enteric Outbreak Surveillance Centre (CEOSC) is an initiative of the Food-Borne, Water-Borne and Zoonotic Infections Division, Population and Public Health Branch, Health Canada. Its purpose is to enable public health professionals from across Canada to have quick and efficient access to enteric outbreak information in the interest of public health protection and response.

The CEOSC user policy defines this surveillance system as follows:

CEOSC consists of two web-based applications, allowing outbreak information to be shared in confidence between regional, provincial/territorial and federal public health officials.
1. **The Enteric Outbreak Alert System** – provides a site for posting “Alerts” about outbreaks or suspected outbreaks currently under investigation which may be of significance to public health professionals in other jurisdictions. The Alert can be important to neighbouring regions only, or to public health professionals from across Canada.

2. **The Enteric Outbreak Summary System** – (currently under development) provides a centralized reporting site for public health professionals to post and document a final report of an enteric outbreak, once the outbreak investigation is completed. This site can be accessed by regional, provincial/territorial and national public health professionals. As a result, information on outbreak trends and occurrence (time, place, source and populations affected) is made current and relevant to public health professionals at all levels of authority.

iv. **Canadian Integrated Public Health Surveillance**

In recognition of the current short comings in health surveillance systems nationally, provincially and territorially, Health Canada has initiated a strategic alliance of public health and information technology professionals “to build an integrated suite of computer and data based tools specifically for use by Canadian Public Health Professionals”. This project is entitled the Canadian Integrated Public Health Surveillance (CIPHS) Programs. The intent is to create an integrated easy to use system which would allow for the capture, integration and forwarding of data by front line health care workers as part of their regular duties.

CIPHS has four main components:

1. The Public Health Information System (iPHIS)
2. The Laboratory Data Management System (LDMS)
3. The Public Health Data Integration Project (PHDI)
4. The CIPHS Collaborative Development Project.

The Ontario Government is currently proceeding with a phased implementation of iPHIS. Pilot projects are underway involving Toronto Public Health, York Regional Health Unit and the Public Health Division of the Ministry of Health and Long-Term Care. The current multi-phase implementation plan calls for the roll out of an integrated iPHIS application for communicable disease reporting to the 37 Ontario Health Units and the Public Health Division beginning in the summer of 2004. Once in place, the Reportable Disease Information System would be retired.

v. **PulseNet**

Pulse Net is the National Molecular Subtyping Network for Foodborne Disease Laboratories. It is linked to sites in all 50 States of the United States and in most Provinces in Canada (Pulse Net Canada). The Canadian network is co-ordinated by the National Microbiology Laboratory, Health Canada in Winnipeg with links to most Provincial Health Laboratories and some other Federal and Hospital laboratories. In Ontario, there are participating sites at the Ontario Public Health Laboratory, Toronto; Sunnybrook Woman’s and Children’s Health Centre, Toronto; the Laboratory for Foodborne Zoonosis, Health Canada, Guelph; and the Food Directorate, Health Canada, Ottawa. Participating laboratories use molecular fingerprinting techniques (pulsed-field gel electrophoresis) to type strains and record the data.
in an electronic database that can provide epidemiological linkages between isolates from different geographical areas or sample types. This molecular epidemiology tool has been extremely useful on a number of occasions (more than 10 investigations in the last two years) to rapidly detect the source of an outbreak and to aid in control measures. This active partnership is also linked to the Canadian Public Health Laboratories Network.

VII. RESEARCH

OMAF funded Food Safety Research offers five main funding programs that provide support to the Meat Inspection Program activities and policy development:

- OMAF-University of Guelph Agri-Food Research Program
- Food Safety Research Program
- New Directions In Agri-Food and Rural Research Program
- Healthy Futures for Ontario Agriculture
- Enhanced Food Quality and Safety Program

Investment in food safety research for the year 2002-2003 was in excess of $3 million.

Research projects in food safety cover three main areas:

- Development and validation of diagnostic methods
- Risk assessment
- Risk management and control

In addition, the Ontario government provides major support to the University of Guelph through contracts to support research and teaching infrastructure in food safety, animal husbandry and veterinary medicine. Federally funded research in food safety also provides important support for the Meat Inspection program. A compendium of food safety research projects currently funded by Agriculture and Agri-Food Canada, Health Canada, and the Canadian Food Inspection Agency lists over 125 projects related to foods of animal origin.

VIII. EMERGENCY PREPAREDNESS

Following the events of September 11, 2001 there was a fundamental change in how Canadians perceived the importance of emergency preparedness in the public health system. These perceptions became further entrenched when the SARS outbreak demonstrated how vulnerable large cities and their infrastructure were to the introduction of an unexpected pathogen. New attention was also focused on food and water supplies, since these systems could be used as vehicles to rapidly disseminate a threat to large numbers of humans, animals, and their environment. In Canada, new initiatives to strengthen preparedness against terrorist attacks included the creation of the CBRN (Chemical, Biological, Radiological, and Nuclear) Research and Technology Initiative (CRTI) which has stimulated a rapid expansion of science capacity to deal with CBRN threats. The CRTI program has also fostered the
The development of Lab Clusters or Networks to build laboratory linkages and capacity. Recently, the Federal government announced the creation of the new portfolio of Public Safety and Emergency Preparedness. It includes emergency preparedness, crisis management, national security, corrections, policing, oversight, and crime prevention and border functions. Provincial and municipal governments have also created enhanced infrastructure such as the creation of the Commissioner of Public Security. The Ontario Emergency Management Act has established emergency preparedness standards to be implemented by all municipalities within well-defined timelines. Unfortunately, linkages between food safety surveillance systems at the private, municipal, provincial and federal levels remain antiquated, under funded and unable to cross-communicate in a real-time fashion.

In the United States there has been a 15-fold increase in Bioterrorism preparedness since 2001. Over 665 new positions were added to the FDA food safety field activities, the number of food import inspections was quadrupled, and threat assessments to the food system were undertaken using the Operational Risk Management analytical framework. Most importantly, surveillance systems were dramatically enhanced by the creation of the Food Emergency Response Network (FERN) and the expansion of the eLEXNET system to include over 97 laboratories in 48 states. This system can track over 3,700 food safety analytes in a rapid, secure and coordinated manner that gives the United States a functional early warning system for threats to the food supply.

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10. OMAF funded Food Safety Research http://www.gov.on.ca/OMAFRA/Eng/food/foodsafety/compendium.htm

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12. CBRN (Chemical, Biological, Radiological, and Nuclear) Research and Technology Initiative (CRTI) www.crti.drde-rddc.gc.ca
CHAPTER 6
MEAT INSPECTION SYSTEMS IN ONTARIO

Canadian meat inspection laws and regulations predate Confederation. In the 1850s, the Canadian Bureau of Agriculture was formed, with responsibilities for disease control in livestock and for meat inspection. Further federal meat inspection legislation was passed in 1873 (Federal Beef and Pork Inspection legislation) and 1907 (Meat and Canned Foods Act) (1). Poultry inspection was included in the 1950’s. In a pattern that continues today, the early evolution of meat inspection in Canada was affected by events abroad. In the 19th century, some European countries imposed meat inspection requirements on importers for control of Trichinella spiralis, a parasite in pork. In the United States, the 1906 publication of Upton Sinclair’s book “The Jungle” raised concerns about conditions in slaughterhouses, and provided impetus for the United States Federal Meat Inspection Act of 1907.

In the early 20th century, acute infectious diseases were leading causes of illness and death, and tuberculosis was a major public health concern. To address these problems, meat inspection focussed on detection of animal disease and general improvement of abattoir hygiene. Some of the standard carcass inspection techniques were devised to detect tuberculosis cattle in order to remove diseased meat from the food chain. The same techniques were also useful for detecting other animal diseases, therefore meat inspection became an important component of the national animal health program (2).

In recent decades the goals and methods of meat inspection have broadened immensely, and there are defined roles for both government and industry. In this chapter, the basic elements of meat and food premises inspection are described, with emphasis on practices currently used in Ontario. In some of the other chapters we have critiqued certain portions of the existing system, however in this chapter we focus mainly on description and address shortcomings and recommendations for improvement in chapter 9.

I. MEAT INSPECTION

Meat inspection (also known as meat hygiene) is the general term for inspection of livestock slaughtered for food. Its principal goals are provision of safe and wholesome meat and meat products for consumers, and contribution to animal health surveillance and humane animal handling. At the federal level, meat inspection also facilitates interprovincial and international trade.

Federal inspection is administered by the Canadian Food Inspection Agency (CFIA). The President of the CFIA reports directly to the Minister of Agriculture and Agri-Food Canada. The Meat Inspection Act and Regulations (Canada) define powers of inspection and outline what has to be done. The federal Manual of Procedures is an administrative document that describes how compliance is achieved (1).

Meat inspection systems for sale of meat sold within provinces vary considerably across the country (Table 6.1). Some provinces have their own inspection systems (Ontario, Quebec, Nova Scotia and Alberta) while others have agreements with the CFIA. Attempts have been made in recent years to standardize meat inspection across the country. To this end, a National Meat & Poultry Code has been
developed. This code, and the question of equivalence of national and provincial standards are addressed further in chapter 9.

Abattoirs must be licensed and are subject to a number of requirements for construction and equipment. These include adequate supply of potable water, ventilation, lighting, sewage disposal, holding pens, stunning and bleeding areas, evisceration and inspection areas, refrigeration facilities, washrooms and others. It is the responsibility of industry to provide the facilities and staff required to comply with the regulations.

### Table 6.1. Provincial Meat Inspection Requirements

<table>
<thead>
<tr>
<th>Province</th>
<th>Licensing</th>
<th>Inspection</th>
<th>Inspection Required for Meat Retail Sale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slaughter</td>
<td>Slaughter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Processing</td>
<td>Processing</td>
<td></td>
</tr>
<tr>
<td>Newfoundland</td>
<td>M</td>
<td>M</td>
<td>V</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>M</td>
<td>M</td>
<td>M*</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>M</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>P.E.I.</td>
<td>M</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>Quebec</td>
<td>M</td>
<td>M</td>
<td>M*</td>
</tr>
<tr>
<td>Ontario</td>
<td>M</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>Manitoba</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>V</td>
<td>NR</td>
<td>M</td>
</tr>
<tr>
<td>Alberta</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>British Columbia</td>
<td>M¹ (in meat inspection designated areas)</td>
<td>V¹</td>
<td>M¹</td>
</tr>
</tbody>
</table>


Legend: M=mandatory; M¹ =mandatory in meat inspection designated areas; V=voluntary; V¹ =not required in designated areas; Y=yes; N=no; NR=not required; *= no inspection required for farm gate sales, custom slaughter; **=cold carcass inspection only; ***=no inspection required for custom poultry slaughter

The province provides the meat inspection services to the 194 provincial abattoirs. In 2002-2003 there were 133 meat inspectors (10 full time and 131 contract) in Ontario who delivered approximately 195 thousand hours of inspection (OMAF data). By April 1, 2004, OMAF anticipated implementation of a new inspector structure with 118 positions. The two classifications and respective numbers are: classified permanent meat hygiene officer, 61; unclassified meat hygiene officer, 57. Inspectors' duties cover the range of activities described below, but most of their time is devoted to ante-mortem and post-mortem inspection of every animal. These inspectors are supported by 4.5 ministry veterinarians. For the most part, their services are provided via telephone to the on-site inspector. One hundred and thirty appointed veterinarians (private practitioners) are on call for the inspection and disease diagnosis regarding living, compromised animals (i.e. veterinary ante-mortem inspection) and/or inspection and
diagnosis regarding suspect carcasses and their accompanying organs (veterinary post-mortem inspection) (Table 6.2).

1. Ante-Mortem Inspection

The objectives of ante-mortem inspection are as follows: determination that animals are live and healthy at the time of slaughter; detection and separation of diseased animals, particularly in conditions that produce no grossly visible lesions at slaughter (e.g. BSE, listeriosis, rabies); emergency slaughter of animals in pain; detection of reportable animal diseases; and provision for humane treatment of animals. An inspector conducts a visual appraisal of the animals within 24 hours of slaughter and if abnormalities are detected, a veterinarian is called in to conduct a clinical examination or is available by telephone for consultation. If no abnormalities are found, the animals are sent to slaughter.

Normally, ante-mortem inspection is conducted in the abattoir by inspectors unaware of the animal’s farm of origin or clinical history. In some instances, however, this may be supplemented by information from the farm. For example, the poultry industry has begun to provide “flock sheets” which describe the health status of birds on farms, and any antimicrobial or other treatments administered to the flock.

Table 6.2. Roles Of Veterinarians In Provincially And Federally Inspected Abattoirs In Ontario

<table>
<thead>
<tr>
<th>Function or Criterion</th>
<th>Roles of Veterinarians in Abattoirs Provincially Inspected by the Ontario Ministry of Agriculture and Food (OMAF)</th>
<th>Roles of Veterinarians in Abattoirs Federally Inspected by the Canadian Food Inspection Agency (CFIA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The overall program design and support involves veterinarians</td>
<td>YES - 4.5 veterinary positions at OMAF headquarters</td>
<td>YES - 8 veterinary positions in Regional Office (Guelph) and additional resources from national headquarters</td>
</tr>
<tr>
<td>The delivery of programs is overseen by veterinarians</td>
<td>YES – At least once per year, an experienced meat hygiene veterinarian under contract to OMAF performs a full 3-day audit of each provincially licensed abattoir.</td>
<td>YES – The CFIA veterinarian-in-charge at each registered abattoir is responsible for the delivery of all inspection programs. – An experienced meat hygiene veterinary supervisor visits each federally registered slaughter establishment 10-12 times a year and conducts a supervisory review.</td>
</tr>
<tr>
<td>Veterinarians are stationed on-site at the abattoir</td>
<td>NO – Each licensed abattoir has one or more OMAF inspectors present during slaughter operations.</td>
<td>YES – Each federally registered abattoir has one or more CFIA veterinarians present on-site during slaughter operations. Primary Product Inspectors working for the CFIA are also present.</td>
</tr>
<tr>
<td>Who inspects animals at the abattoir before (ante-mortem) and after (post-mortem) they are slaughtered?</td>
<td>An OMAF inspector inspects each animal ante and post mortem. The inspector approves all normal animals and carcasses. All abnormal animals and carcasses (including their parts) are held by the inspector who will consult by telephone with an OMAF staff veterinarian.</td>
<td>A CFIA Primary Products Inspector inspects each animal ante and post mortem. The inspector approves all normal animals and carcasses. All unusual animals and carcasses (including their parts) are held by the CFIA inspector and are subject to a more detailed inspection by a CFIA veterinarian.</td>
</tr>
<tr>
<td>Function or Criterion</td>
<td>Roles of Veterinarians in Abattoirs Provincially Inspected by the Ontario Ministry of Agriculture and Food (OMAF)</td>
<td>Roles of Veterinarians in Abattoirs Federally Inspected by the Canadian Food Inspection Agency (CFIA)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>The OMAF staff veterinarian obtains vital information from the inspector over the phone and determines the disposition of the animal (approve / condemn / partially condemn / hold for inspection by appointed veterinarian / hold for testing). If called upon to do so, an OMAF appointed contract veterinarian will visit the plant to perform a detailed post-mortem inspection of the carcass and parts OR ante-mortem and post-mortem inspection of the animal, carcass and parts and will decide on the disposition (approve/partially approve/hold &amp; test/condemn) of the animal and carcass.</td>
<td>The CFIA veterinarian will decide on disposition (approve / condemn / partially condemn / hold for testing).</td>
</tr>
<tr>
<td>Other duties performed by the veterinarian at the abattoir</td>
<td>Not applicable</td>
<td>Functional supervision of all CFIA inspectors at the abattoir verification of compliance with other meat hygiene requirements export certification of meat products</td>
</tr>
<tr>
<td>Number of Veterinarians performing meat hygiene work in abattoirs</td>
<td>130 appointed contract veterinarians available on call. Note: Meat hygiene duties make up a very small part of the overall practice of appointed contract veterinarians.</td>
<td>64 full-time, government-employed veterinarians stationed at abattoirs. Note: There is more than one CFIA veterinarian stationed at large abattoirs or abattoirs operating multiple shifts.</td>
</tr>
<tr>
<td>Number of Provincially Licensed / Federally Registered abattoirs in Ontario</td>
<td>194</td>
<td>32</td>
</tr>
<tr>
<td>Amount of Meat coming from Provincially vs. Federally Inspected abattoirs in Ontario</td>
<td>Approximately 15% Note: Many higher risk animals (e.g. downers) are slaughtered in smaller abattoirs and most of these abattoirs are under provincial inspection.</td>
<td>Approximately 85%</td>
</tr>
<tr>
<td>Professional Requirement for veterinarians performing meat hygiene work in abattoirs</td>
<td>Member of the College of Veterinarians of Ontario</td>
<td>Degree from a recognized school of veterinary medicine plus eligibility for membership in a Canadian veterinary association.</td>
</tr>
<tr>
<td>Percentage of Cost-Recovery for Services collected by the government</td>
<td>Zero</td>
<td>10-13% of estimated costs.</td>
</tr>
<tr>
<td>Veterinary Inspection of Further Processing in Abattoirs</td>
<td>Minimal (auditor yearly)</td>
<td>Veterinarian is present in plant at all times</td>
</tr>
</tbody>
</table>

i. Downer animals
Another important example of an on-farm component to ante-mortem inspection is the requirement in Ontario for on-farm veterinary examination and certification of non-ambulatory or so-called “downer” animals, which are usually cattle. These are animals that, due to injury or disease, are unable to stand or walk without assistance or are unable to move without being dragged or carried onto trucks for transport to slaughter. This program is unique to Ontario, and requires that the attending veterinarian determine the likely causes of recumbancy, describe any treatments that may have been administered, and determine whether the animal can be humanely transported to slaughter. This information is provided on the certificate, which is signed by the veterinarian, and is available for the use of inspectors at the abattoir.

The issue of downer animal slaughter is controversial on both humane and food safety grounds. Some countries have banned the practice while others provide for supervised on-farm slaughter. The two recent BSE cases in Canada and the United States were both apparently downer cows, but there are other food safety concerns including antimicrobial residues and diseased tissue. Many downers, however, are recumbent because of injury, and provided that humane considerations are addressed and damaged tissues are removed, wholesome meat from them can be safely salvaged and used. OMAF inspectors test carcasses of all downer animals for antimicrobial residues. Currently downers are also an important risk group for BSE surveillance. If, sometime in the future, downers are no longer accepted for slaughter, other means will have to be found to obtain appropriate surveillance samples from this population of animals. The issue of downer animals is addressed further in chapters 8&9.

ii. Humane slaughter

Humane slaughter considerations include transport of animals to slaughter, handling and housing within the facility, and the actual stunning and killing procedures. Transport of non-ambulatory animals is an example of a humane slaughter concern. Most livestock is transported directly from the farm to the abattoir. However, many animals are diverted through 37 auction markets distributed throughout Ontario. These locations are regulated under the Livestock Community Sales Act and Regulation. The legislation requires that the animal health and animal welfare of all the livestock is assessed each day of the sale by an OMAF-appointed veterinarian. Forty veterinary practitioners are appointed to assist with this program. Some of these assembled animals are sold and transported back to farms for further growth or production; others are sold to abattoirs for slaughter.

The transportation of live animals is regulated by the CFIA and the Health of Animals Act and Regulations. This applies throughout Canada, including Ontario. To further strengthen the animal welfare provisions of this legislation, Ontario developed the Transporting Non-Ambulatory Animals Regulation under their Livestock and Livestock Products Act. This latter regulation applies at locations where livestock are loaded, unloaded or transported, including downers at the farm level, interim unloading/loading stations, and abattoirs.

There are provincial and federal regulations governing humane handling and pre-slaughter stunning of animals within slaughter establishments, and inspectors must enforce those regulations.

2. Post-Mortem Inspection

The objectives of post-mortem inspection are to identify diseased or unwholesome tissue. Once the animals are killed, carcasses are individually inspected at various stages in the evisceration and
dressing process. The methods and procedures used vary depending on the species, but basically, tissues are examined for the presence of visible or palpable lesions (diseased tissue such as abscess or pneumonia) or other abnormalities (e.g. fecal contamination). If problems are detected, steps are taken to determine the extent of involvement, for example localized to one area or generalized throughout the carcass and organs. Inspectors conduct the routine examinations, and veterinarians are called in to evaluate diseased or otherwise abnormal carcasses.

i. Ritual slaughter

The meat inspection regulations in Ontario allow the ritual slaughter of animals in accordance with religious practice. However, in accordance with meat inspection regulations, all meat and meat products that are declared fit for human consumption are derived from animals that were approved during ante-mortem and post-mortem inspection at the provincially licensed meat plants. Provision has also been made to accommodate individuals or families who want to observe certain religious practices, and wish to take meat home immediately (within 2 hours) after slaughter for immediate cooking or freezing, therefore minimizing opportunity for spoilage or growth of pathogens. This does not apply to any other meat products that are sold or distributed from the plant; these must be refrigerated in the plant and during transport. This is good practice, because it provides access to inspected meat for people observing religious obligations.

3. Laboratory Testing In Meat Inspection

Another important role of inspectors is collection of samples for laboratory testing. Conceptually, there are two main types of laboratory testing programs associated with meat inspection. The first, sometimes called “monitoring”, is intended to identify trends in the occurrence and concentration of contaminants in meat from across the province. It is usually not practical to hold carcasses or product sampled for monitoring purposes, therefore this meat is usually distributed and/or consumed before test results are available. Samples for monitoring are randomly collected from carcasses at slaughter, from a range of plants. Monitoring programs provide valuable baseline information upon which the progress of food safety programs and plant performance can be assessed, and systematic problems in need of intervention can be identified. The role of baseline studies of chemical and microbial contaminants of meat is described further in chapters 5&7. The second type of testing program, sometimes called "surveillance", is targeted at animals at elevated risk of contamination, and the results are used to assist inspectors in making decisions concerning the safety of meat from individual suspect animals or groups of animals. For this type of program, sampled carcasses or product are held pending results of laboratory testing. Inspectors and veterinarians may collect samples for laboratory testing if they believe the additional information could be helpful in determining the nature or extent of disease or contamination in the carcass. Examples include sampling of muscle and kidney for antimicrobial residue testing from animals suspected of recent treatment (e.g. downers, leg infections, mild pneumonia), and tissues for histological examination for neoplasia (cancer) by a veterinary pathologist. In Ontario, the Laboratory Services Division of the University of Guelph provides these services.

4. Condemnation And Dispositions

Animals and carcasses may be condemned in whole or in part as unfit for human consumption based on the findings from ante- and post-mortem inspection. Dispositions are the actions taken by
inspectors when abnormalities are found, and may include trimming, condemnation, treatment by freezing or further processing, and decisions concerning the utilization of condemned material (i.e. use for animal food, rendering, or totally condemn and incineration). The general criteria include the presence of localized or generalized disease, the nature of the disease or condition present (e.g. acute versus chronic, benign versus malignant), and consideration of the public health significance of the condition. There are also specific criteria for individual diseases, lesions or conditions. Examples include abscess, adhesions, arthritis, fever, hepatitis, injection sites, nephritis, pneumonia, and toxaemia. Most diseases and conditions detected in Ontario animals are not of public health significance, but are removed because they are repugnant to consumers. Condemned animals and tissues must be handled properly to ensure that they do not accidentally or fraudulently re-enter the food chain, or lead to contamination of edible product.

5. Capabilities & Limitations Of Traditional Ante-Mortem And Post-Mortem Inspection

Traditional ante-mortem and post-mortem inspection is designed to detect clinical diseases and conditions in livestock, and carcass-by-carcass inspection is reasonably capable of that function. This information is valuable for animal health surveillance and for removing diseased meat from the human food chain. It is clear, however, that traditional inspection techniques are incapable of detecting most of the carcasses contaminated with many of the important foodborne infectious agents that occur in livestock, such as *Salmonella*, *Campylobacter*, *E. coli* O157:H7, *Toxoplasma* and *Listeria* because these infections usually do not produce grossly visible lesions in carcasses (3). Similarly, chemical residues are invisible and therefore not detectable using organoleptic (i.e. sight, touch, smell) techniques. Therefore, it is important to have complementary safeguards in place, such as those incorporated into good HACCP and HACCP-based programs (see chapter 2).

II. PROCESSING INSPECTION

Of the 110 inspectors currently on OMAF staff, 37 are fully trained and have met the OMAF requirements to conduct inspections in further processing plants. In addition, 10 OMAF supervisors and program support-scientists provide expertise in the meat inspection requirements of further processing plants; these individuals oversee the work of the plant inspectors and provide back-up support.

Depending on the need for more further-processing inspectors, decision makers (supervisors) invite primary product inspectors to apply for more advanced training. The potential candidates are those that in the past have expressed an interest and possess a demonstrated ability or aptitude. The Food Inspection Branch is upgrading the further-processing skill level of its inspectors. Resource constraints, recent hiring and the difficulty in scheduling staff (due to the first priority of primary processing inspection) continue to interfere with additional training.

Once carcasses pass inspection, they undergo further-processing and distribution prior to consumption. Chemical contaminants are usually minimally affected by processing, but meat is a highly perishable commodity and processing and handling steps are critically important to microbial food safety. Examples of processing steps include cutting, grinding, freezing, cooking, smoking, drying, fermenting, and curing.

Survival, growth and death of pathogenic (disease-causing) and non-pathogenic (often spoilage-causing) microorganisms are greatly affected by a number of characteristics of food, including among
others, pH, temperature, water activity (a_w; a measure of the water available for microbial growth), oxidation-reduction potential (related to oxygen content), presence of competitive harmless bacteria, and presence of inhibitors or preservatives (additives, e.g. nitrite) (see chapter 5). These factors, individually or in combination, are the scientific bases for the effectiveness of traditional meat preservation techniques, including drying, curing, smoking and salting. Most pathogens are also killed by cooking or irradiation, although the prions associated with BSE are resistant to most treatments.

1. Microbial Ecology Of Raw And Processed Meat

Live animals carry a wide variety of both pathogenic and harmless microorganisms on their skin and on internal body surfaces (e.g. within intestines). Some of these infections are introduced on the farm, but others may be encountered during transport from contact with other animals or from contaminated vehicles or shipping crates. Meat is for practical purposes free of bacteria in the live animal, but muscle tissues may contain parasites if the animal is infected (e.g. *Trichinella spiralis*, *Toxoplasma gondii* or *Cysticercus spp*). Fortunately most of these parasites are rare or absent in Ontario.

As the skinning and dressing procedures commence there is invariably some contamination of the outside and inside surfaces of the carcass from equipment, workers hands, adjacent carcasses, airborne droplets, or in the case of poultry, defeathering operations and immersion chill tanks. Proper techniques (e.g. sanitizing of knives in potable water above 82°C, frequent hand washing) reduce but do not eliminate such contamination. If visible fecal contamination occurs, affected areas must be trimmed. Some establishments have introduced other interventions for surface decontamination of carcasses, including carcass rinses with or without chlorine or organic acids, and steam treatments of surfaces.

Raw chilled meat may be contaminated on surfaces with a variety of spoilage-causing bacteria (most of which are not disease-causing) as well as pathogens, such as *Salmonella*, *Campylobacter jejuni*, *Yersinia enterocolytica*, *E. coli* O157:H7, and *Clostridium perfringens*, among others. These bacteria may contaminate other foods or people during handling and processing. Additional handling may add other organisms to the surface, and when meat is ground (comminuted), or obtained by mechanically deboning, the surface contaminants are distributed throughout the product. Therefore ground meat and fresh sausage may contain pathogens.

Further processing steps that kill or limit microbial growth include cooking, curing, fermenting, smoking and drying. Proper cooking kills nearly all pathogens but recontamination of cooked product may occur and must therefore be prevented. Some products are raw cured (e.g. bacon, some ham) or “cold smoked” and while these treatments have some antimicrobial properties, refrigeration is usually required to prevent further microbial growth, and these products are intended to be cooked prior to consumption. Hams are cured and often sold fully-cooked. Some sausages are fermented (e.g. salami) and the most critical safety factor in their processing is rapid production of acid by the harmless fermenting bacteria to prevent growth of *E. coli*, *Staphylococcus* or other harmful bacteria. Smoking and drying are also used to preserve these products. Uncured meat (pH>4.6) that is canned or stored in jars, bottles or other containers or packaging that restricts entry of oxygen is treated with a time-temperature sufficient to kill $10^{12}$ *Clostridium botulinum* spores, the causative agent of botulism.

Inspection of processing has traditionally focused on sanitation of facilities and equipment, ensuring the use of approved formulations and ingredients, ensuring that products do not become
adulterated, and that necessary steps are taken to reduce contamination and control pathogen growth in meats. Considerable attention is also given to carcass chilling techniques and refrigeration and freezing facilities.

III. OMAF MEAT INSPECTION TRAINING

The Mission of OMAF's Food Inspection Branch is to:

- lead in the development of science-based food safety policies and standards
- efficiently deliver compliance and enforcement programs that will maintain safe, wholesome foods
- provide the basis for high levels of consumer confidence in a competitive Ontario food production, processing and distribution industry.

i. Orientation Training (for newly hired meat hygiene officers)

**Head Office Orientation**

Initial orientation at head office (OMAF - Guelph) - two days

The new employee is provided with required equipment and reference materials:

- Ontario Meat Inspection Act
- Meat Inspection Policy and Procedures Manual (MIPPM)
- Standards of Compliance
- Registration to the distance video courses.

**Field Placement #1**

The employee is assigned to provincial abattoirs that are designated training plants with experienced, knowledgeable inspectors that provide job-shadowing training. Each employee must be trained to inspect the three major species (beef, hogs and poultry)

**Classroom Session**

Following completion of the above, the employee participates in a four week classroom session along with other employees, after which candidates must pass an examination. The subjects covered are:

- Basic Meat Hygiene
- Animal Physiology and Pathology
- Sampling and Monitoring Program
- HACCP
- Occupational Health and Safety
- Communication and Interpersonal Skills
- Bovine Spongiform Encephalopathy (BSE) and Specified Risk Materials (SRM) training courses
• Further Processing Level 1 (all activities in abattoirs up to but not including the production of Ready-to-Eat (RTE) meat products)
• Food Safety Decision Support System and Computer Training
• Professional Code of Conduct Training
• Conflict Management Course

**Field Placement #2**

The employee is again assigned to provincial abattoirs to gain further field experience and apply the information learned at the classroom sessions. Again the individual works in each of the three species. Two Area Managers (who are from areas different from the area to which the trainee will be assigned) conduct the final assessment of a trainee. The assessment is a day in length with both Area Managers present. The minimum period of time a trainee undergoes orientation training is four months; new employees are on probation for eight months.

**ii. Open Learning and Continuing Education**

A trainee or a full time inspector can access distance video courses at any time. Staff members are provided with binders and are encouraged to complete the training on their own time and at a speed they are comfortable with. There are four course binders:

- Meat Industry Basics I
- Meat Industry Basics II
- Meat Technology

The Meat Industry Basics binders will be replaced in 2004 with Food Handler Training binders. A list of the available Open Learning Meat Inspection Training Videos is shown in Table 6.3.

<table>
<thead>
<tr>
<th>No.</th>
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<th>Viewing Time</th>
<th>Comments</th>
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<tr>
<td>1</td>
<td>In Plant Duties of the Ontario Meat Inspector</td>
<td>Examines broad areas of responsibility of the meat inspector, from facility inspection to ensuring sanitary transportation of meat</td>
<td>20 minutes</td>
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<td>2</td>
<td>Health and Hygiene in the Meat Plant… Canada Meat Packers Pt.1</td>
<td>Reviews for meat plant operators principles of hygiene to control microorganisms in the plant</td>
<td>18 minutes</td>
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<td>3</td>
<td>Sanitation and Handling in Meat Plants….. Canada Meat Packers Pt 2</td>
<td>Reviews for meat plant operators the facilities and procedures that help ensure safe meat supply</td>
<td>22 minutes</td>
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<tr>
<td>4</td>
<td>The Legislation Affecting Meat Plants… Canada Meat Packers Pt. 3</td>
<td>Reviews for meat plant operators the relevant municipal, provincial, and federal legislation affecting their plant operations</td>
<td>22 minutes</td>
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<td>5</td>
<td>Special Handling Procedures pt. 1</td>
<td>How to handle a number of specific red meat slaughter situations. Covers in-plant meat inspection and inspection under jurisdiction of the Livestock Community Sales Act and the Beef Cattle Marketing Act</td>
<td>9 minutes</td>
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<td>6</td>
<td>Food Safety in No Mystery</td>
<td>Story of Benny… A review of food safety issues in home and food service industry.</td>
<td>33 minutes</td>
<td>A USDA video</td>
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<td>7</td>
<td>60 Minutes…Segment on Poultry Plant Contamination</td>
<td>Documentary on USDA’s lax treatment of contamination in a high production Missouri poultry plant.</td>
<td>15 minutes</td>
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<td>8</td>
<td>Humane Handling &amp; Slaughtering</td>
<td>A discussion of management approaches and equipment to ensure a humane slaughter for all animal species.</td>
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<td>Ante Mortem Inspection</td>
<td>Red meat animal characteristics that alert the meat inspector to problems in ante mortem inspection, and how to respond</td>
<td>34 minutes</td>
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<td>Ante mortem inspection of Livestock, Poultry, and Rabbits</td>
<td>Brief discussion of how to conduct an ante mortem inspection on the various animal species</td>
<td>11 minutes</td>
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<td>11</td>
<td>Basic Post Mortem</td>
<td>General review of principles and approaches in post mortem meat inspection to detect animal pathology and operational defects.</td>
<td>38 minutes</td>
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<td>Post Mortem Meat Inspection</td>
<td>Discussion of post mortem inspection, relating to all animal species</td>
<td>26 minutes</td>
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<tr>
<td>13</td>
<td>Inspection of Poultry</td>
<td>A comprehensive review of poultry anatomy, slaughter and dressing procedures, and ante and post mortem inspection of poultry</td>
<td>50 minutes</td>
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<td>14</td>
<td>Poultry Condition and Carcass Disposition</td>
<td>A summary of poultry injuries, deficient dressing procedures, and pathologies which trigger whole or partial condemnation</td>
<td>41 minutes</td>
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<td>15</td>
<td>Emu Slaughter</td>
<td>Outlines information regarding emu production, slaughter techniques, and inspection</td>
<td>23 minutes</td>
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<td>16</td>
<td>Poultry Grade Monitoring</td>
<td>Reviews criteria used for establishing poultry grades</td>
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<td>17</td>
<td>Swine Dressing and Inspection Procedures</td>
<td>Outlines procedures for sanitary hog dressing as well as visceral and carcass rail inspections</td>
<td>47 minutes</td>
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<td>Cattle Carcass Dressing, Eviscerating, and Inspection</td>
<td>A thorough examination of animal pathologies and dressing deficiencies that a cattle post mortem inspection will reveal.</td>
<td>76 minutes</td>
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<td>Cattle Head Dressing and Inspection</td>
<td>Proper head dressing techniques to ensure sanitation, and pathologies to look for</td>
<td>34 minutes</td>
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<td>20</td>
<td>FMD: The Front Line</td>
<td>This video prepares animal health professionals in recognition and approach to Foot and Mouth Disease</td>
<td>23 minutes</td>
<td>Belongs to Guelph H.O. Dr. Vanderwoude Australia 1993</td>
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<td>21</td>
<td>Streamlined Inspection System for Broiler Chickens</td>
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<td>WHMIS</td>
<td>Right to know, General overview to Hazardous Materials, MSDS, Ind. Hazards</td>
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<td>Meat Processing Operation Mini Modules 2 and 3</td>
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<td>Preparation of Offals, Disposition of Inedible Meats, including Carcasses and Portions</td>
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<td>Post Mortem inspection of Rabbits, 2Nd Edition</td>
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<td>Sanitation and Handling in Meat Plants….. Canada Meat Packers Pt 2</td>
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<td>30 minutes</td>
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<td>Live Stock Community Sale - Livestock Handling Naturally</td>
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<td>The Brain Eater</td>
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<td>Ante Mortem Inspection – Cattle</td>
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<td>Ante Mortem Inspection - OMAFRA 1986</td>
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<td>Marketing Beef Cattle in Ontario</td>
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<tr>
<td>32</td>
<td>WHMIS</td>
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<td>33</td>
<td>&quot;48 Hours&quot; Is our Food Safe?</td>
<td>Feb. '94 - HACCP System</td>
<td>22 minutes</td>
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<td>FMD – The Front Line</td>
<td>Foot &amp; mouth Disease (Produced by CSIRO Australian Animal Health)</td>
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<td>Television News Reports</td>
<td>HFA's Expose of IBP</td>
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<td>Brain Tissue Collection Techniques for BSE</td>
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<td>The Legislation Affecting Meat Plants</td>
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<td>Canadian Meat Packers</td>
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<td>Meat Industry Basics Part 1</td>
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<td>16 minutes</td>
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<td>Slaughter of Cattle</td>
<td>19.19 minutes</td>
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<td>Slaughter of Lambs</td>
<td>13.16 minutes</td>
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<td>15.53 minutes</td>
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<td>47</td>
<td>VTEC Inspectors Orientation Tape # 1 &amp; 2</td>
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<td>OMAF TV Service</td>
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<td>Finished Product Standard</td>
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<td>50</td>
<td>Food Safe, Food Smart</td>
<td>HACCP and its application to food industry part 1 &amp; 2</td>
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<td>Alberta Agri, Food &amp; Rural Dev.</td>
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<td>51</td>
<td>Vet 50, Zoonoses of Slaughterhouse Workers and Meat Handlers</td>
<td>41 slides and workbook for veterinary continuing education</td>
<td>78 minutes</td>
<td>Royal Vet College, London, England</td>
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<td>52</td>
<td>Think Clean</td>
<td>Food Safety in Health Care Institutions</td>
<td>46 minutes</td>
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<td>53</td>
<td>Tape # 12 Writing the HACCP Plan</td>
<td>Glen R. Schmidt, PhD for the American Association of Meat Processors</td>
<td>?</td>
<td>Colorado State University</td>
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<td>54</td>
<td>Post-mortem inspection of sheep, lambs, and goats (#13) and horses (#14)</td>
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<td>10 minutes</td>
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<td>55</td>
<td>Meat Cuts Preparation and Identification</td>
<td>Part 1 only</td>
<td>25 minutes</td>
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<td>56</td>
<td>Health and Safety</td>
<td>Let's Work for it</td>
<td>11.43 minutes</td>
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<td>57</td>
<td>Sanitation</td>
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<td><strong>Continuing Ed Videos for FIB Inspectors, Veterinarians and Appointed Veterinarians</strong></td>
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<td>58</td>
<td>Vet 50, Zoonoses of Slaughterhouse Workers and Meat Handlers</td>
<td>41 slides and workbook for veterinary continuing education</td>
<td>78 minutes</td>
<td>Royal Vet College, London, England</td>
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<td>59</td>
<td>Exotic Disease</td>
<td>Think the Worst First</td>
<td>5.37 minutes</td>
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<td>60</td>
<td>Exotic Disease</td>
<td>The Nation's Nightmare</td>
<td>6.01 minutes</td>
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<td>Exotic Disease</td>
<td>Stop the Spread</td>
<td>6.51 minutes</td>
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<td>To Market, To Market</td>
<td>5.30 minutes</td>
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<td>63</td>
<td>Exotic Disease</td>
<td>Vital Signs</td>
<td>8.31 minutes</td>
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<td>Outbreak Confirmed 1</td>
<td>Stamping It Out; An Intro to disease control</td>
<td>15.06 minutes</td>
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<td>First Things First; Slaughter and Disposal of Sheep and Cattle</td>
<td>13.26 minutes</td>
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<td>Outbreak Confirmed 3</td>
<td>First Things First; Slaughter and Disposal of Pigs</td>
<td>12.23 minutes</td>
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<td>Outbreak Confirmed 4</td>
<td>First Things First; Slaughter and Disposal of Poultry</td>
<td>9.26 minutes</td>
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<tr>
<td>68</td>
<td>Outbreak Confirmed 5</td>
<td>Cleaning It Up; Decontamination of Property and Equipment</td>
<td>13.16 minutes</td>
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<td>70</td>
<td>The Brain Eater</td>
<td>Bovine Spongiform Encephalopathy (Mad Cow; BSE)</td>
<td>60 minutes</td>
<td>PBS Nova</td>
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<td>Foreign Animal Diseases</td>
<td>Foot and Mouth, General</td>
<td>7.3 minutes</td>
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<td>72</td>
<td>Foreign Animal Diseases</td>
<td>Foot and Mouth Disease in Swine scientific</td>
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<td>Foot and Mouth Disease in Cattle scientific</td>
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<td>USDA</td>
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<td>74</td>
<td>What If…FAD Emergency Organization</td>
<td>April 1st, 1996</td>
<td>18 minutes</td>
<td>AAAC &amp; Revenue Canada</td>
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<td>Livestock Transport</td>
<td>The Rules of the Road</td>
<td>10.30 minutes</td>
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**Public education, TV, News and Town and Country Videos related to Further Processing, Meat Inspection and Food Safety**

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<td>76</td>
<td>Organoleptic Meat Inspection</td>
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<td>T &amp; C OMAF</td>
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<td>77</td>
<td>Legal Aspects of Meat Inspection</td>
<td>16.4 minutes</td>
<td>TV services OMAF</td>
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<td>78</td>
<td>US Meat Inspection Dateline April 2001</td>
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<td>79</td>
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<td>SuperBugs</td>
<td>Country Canada, CBC, Jan 20th 1999</td>
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<td>81</td>
<td>Food Safety Special</td>
<td>TC069899 Dr. Gwen Zellen, Food Safety</td>
<td>T &amp; C OMAF</td>
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<td>82</td>
<td>Le Dossier Noir De La Viande Rouge</td>
<td>20 November 1991, Radio Canada (french) Enjeux 2100 60 min</td>
<td>Bowdens</td>
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<td>83</td>
<td>ABC Reports Prime Time Live</td>
<td>Tainted Meat at a Jack in the Box Restaurant February 7th 1993</td>
<td>4 minutes</td>
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<td>84</td>
<td>Newsline</td>
<td>Consumer Beware buying of Meat</td>
<td>12.23 minutes</td>
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<td>85</td>
<td>Egg to Plate Food Safety</td>
<td>Field-to-fork, HACCP - based broiler production food chain in Ontario</td>
<td>10 minutes</td>
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<td>86</td>
<td>Anti-microbial Resistance</td>
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<td>T &amp; C OMAF</td>
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<td>87</td>
<td>Partners</td>
<td>Episode # 3 - Food Safety</td>
<td>MOHLTC et al</td>
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</table>

### iii. Advanced Learning Courses for Meat Inspectors

Experienced staff can apply for and participate in the following courses as determined by their supervisors (Area Managers):

- Deadstock Inspection and Disposal Training
- Further Processing Level 2 (all activities in Level 1 and includes all forms of processed and RTE meat including cold smoking, but excluding dry-cured, fermented, dried muscle and canned product)
- Further Processing Level 3 (all activities in Levels 1 and 2 and includes inspection of dry-cured, fermented, dried muscle and canned products (high risk))
- Improving the Safety of RTE Meat Products

### iv. Refresher/ Special Issue/ Impromptu Training Courses
• In-plant residue testing
• Thyroid gland collection training
• BSE (Bovine Spongiform Encephalopathy), Foot and Mouth Disease (FMD) and SRM (Specified Risk Material) courses and video training packages
• HACCP introduction and HACCP-based program training

v. Veterinary Specific Training
• Initial 'Appointed Veterinarian' Pathology and Disposition Training
• Professional Update course (CFIA delivered)
• Practitioner's Manual for Handling Non-Ambulatory Animals
• Manual for Livestock and Sales Barns (Livestock Community Sales Act)

1. New Training Initiatives

i. Food Handler Training Course

This course will be available to all OMAF staff in a distance learning format. The Ontario Independent Meat Processors (OIMP) is a partner in the initiative, with the sole rights to administer the program to industry. The course was made available in March 2004.

ii. Inspector, Investigation and Enforcement Course

This course is being delivered in four locations throughout Ontario in 2004. The eight Area Managers are expected to take this one-week course that involves 13 Ministries and is intended to ensure that core competency consistencies are respected.

iii. Ontario Regional Food Safety Node

The Ontario Regional Food Safety Node is a collaborative initiative involving OMAF, CFIA, Health Canada and Agriculture and Agri-Food Canada. This organization has identified the need to develop a comprehensive training program for meat inspectors in the provincial and federal systems as well as other related programs in food safety. To help accomplish this, the training program for Meat Inspectors in Ontario is under review as part of a special project being conducted by OMAF and the University of Guelph. The purpose of this review is to establish a common standard of training for Meat Inspectors and to provide recommendations on the implementation of a program that will develop the basic skills, knowledge and core competencies required for the effective delivery of meat inspection.

iv. Further Processing Inspector Training

The training will be hands-on instruction to ensure competency with and proper care of food processing equipment and inspection (e.g. calibration, pH meter, Aw meter, salimeters, thermometer, nitrite/nitrate calculations and label review).

v. Current Status

Food Inspection Branch managers expected to have their new meat hygiene inspectors hired by the end of March 2004. The two classifications and respective numbers are: classified permanent meat hygiene officer, 61; unclassified meat hygiene officer, 57. Most of these individuals are currently working
as temporary staff (as well as a few of the original full-time staff); as a result, many of the staff will have received previous training. Therefore, while there are indications that demands will be great, it is believed the training personnel are well positioned to meet the need.

One area that needs improvement is the tracking system to maintain a record or training inventory of each inspector. The newly appointed Further Processor and Veterinary Training Coordinator indicated that she is working toward the establishment of such a system.

As can be seen by the variety of courses listed, there is a combination of in-house OMAF trainers as well as a variety of outside trainers. Using suitable abattoirs that have mentoring, knowledgeable inspectors/trainers on staff and combining that with external experts with more specialized knowledge, the training plan appears to be significant.

IV. FOOD PREMISES INSPECTION

i. Health Protection and Promotion Act

Responsibility for inspection of restaurants lies with the Public Health Units. The authority for inspection is provided in the Health Protection and Promotion Act (HPPA) and its accompanying guidelines, protocols and regulations. The HPPA designates programs which all 37 Ontario Health Units are to provide – the Mandatory Health Programs and Services. These include Community Sanitation and Control of Infectious Diseases both of which relate to meat inspection.

The HPPA defines a food premise as follows:

“Food Premise” means a premise where food or milk is manufactured, processed, prepared, stored, handled, displayed, distributed, transported, sold or offered for sale, but does not include a private residence.

Sections 16 & 17 of the HPPA state, in part:

16. (1) Every person who operates a food premise shall maintain and operate the food premise in accordance with the regulations.

Notice of intention to commence operation

(2) Every person who intends to commence to operate a food premise shall give notice of the person’s intention to the Medical Officer of Health of the Health Unit in which the food premise will be located.

Records

(5) Every person who operates a food premise shall keep such records in respect of the manufacturing, processing, preparation, storage, handling, display, transportation and sale, or offering for sale of food on or in the food premise and the distribution of food from the food premise as are prescribed by the regulations, and shall keep the records in such form, with such detail and for such length of time as are prescribed by the regulations. R.S.O. 1990, c. H.7, s 16.

17. Sale of diseased food
No person shall sell or offer for sale any food that is unfit for human consumption by reason of disease, adulteration, impurity or other cause.

Seizure by the Medical Officer of Health or a Public Health Inspector and destruction of food designated a health hazard is provided for under Section 19 of the Act.

ii. Food Premises Regulation (OR 562/01)

The regulations under the HPPA detail the requirements for the operation of any food premises including restaurants. This encompasses general sanitation standards regarding the storage and handling of food as well as requirements for building maintenance. Sections 37 – 41 of the regulation deal with meat and meat products. These Sections mandate that any meat sold from a food premise must have been inspected under either the Ontario Meat Inspection Act or the Meat Inspection Act (Canada). An exemption is provided for a food premise located at the Sioux Lookout Meno-Ya-Win Health Centre and also for uninspected meat for the purpose of custom cutting, wrapping and freezing for its owner if:

(a) the uninspected meat is stored so that it does not come into contact with inspected meat;

(b) each quarter or larger section of the carcass bears a tag showing the name and address of the owner of the uninspected meat;

(c) each quarter or larger section of the carcass is legibly stamped “Consumer Owned, Not For Sale” on each of the prime cut areas using ink made from non-toxic edible ingredients and in letters at least 1.25 centimeters in height.

iii. Mandatory Health Programs and Services Guidelines

Section 7 of the HPPA grants the Minister of Health and Long-Term Care authority to “publish guidelines for the provision of mandatory health programs and services and every Board of Health shall comply with the published guidelines”. Consequently, the Mandatory Health Programs and Services Guidelines (MHPSG) have the force of regulations.

In fact, the Minister has published guidelines on a number of occasions, the most recent being December 1997. The MHPSG define three General Standards (Equal Access, Health Hazard Investigation, and Program Planning and Evaluation) and 14 Program Standards. The standards are evidence-based and represent the minimum requirements to be carried out by each of the 37 Boards of Health in Ontario.

Food Safety is one of the 14 Program Standards. The Food Safety Program Standards are important from the perspective of preventing food-borne illness from food premises such as restaurants. One standard requires that a risk assessment be undertaken for all food premises within the jurisdiction of each Board of Health and based upon this assessment each food premise is to be designated either high, medium or low risk. “High-risk” food premises are those which prepare hazardous foods and serve to a high-risk population (e.g., nursing homes and hospitals), use processes involving many preparation steps and foods frequently implicated as the cause of food-borne illness (e.g., full menu restaurants), and/or have been implicated as a source of food-borne illness/outbreak. “Medium-risk” food premises are those which prepare hazardous foods without meeting the criteria for high-risk (i.e., fast food restaurants) and/or prepare non-hazardous foods with extensive handling or high volume (e.g., bakeries). “Low-risk”
premises are those which do not prepare hazardous foods but may serve prepackaged hazardous foods, e.g., convenience stores (Table 6.3).

The Food Safety Program Standards go on to state that the risk assessment process and inspection frequency and requirements be in compliance with the Hazard Analysis Critical Control Point (HACCP) Protocol published by the Ministry of Health and Long-Term Care January 1st, 1998.

Table 6.3. Food Premises in Ontario, By Risk Category, 2003

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Number</th>
<th>Percent</th>
<th>Average Number per Health Unit</th>
<th>Median per Health Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>17,879</td>
<td>23 %</td>
<td>483</td>
<td>220</td>
</tr>
<tr>
<td>Medium</td>
<td>31,706</td>
<td>40 %</td>
<td>857</td>
<td>443</td>
</tr>
<tr>
<td>Low</td>
<td>29,104</td>
<td>37 %</td>
<td>787</td>
<td>441</td>
</tr>
<tr>
<td>Total</td>
<td>78,689</td>
<td>100 %</td>
<td></td>
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</table>

Note: does not include Seasonal, New and Closed Premises.
Source: Public Health Division, Ministry of Health and Long-Term Care.

From a food preparation perspective, the Food Safety Program Standards require that each Board of Health “ensure that food handler training courses are provided in accordance with the Ministry of Health and Long-Term Care Food Handler Training Protocol (January 1st, 1998) to food handlers in high and medium risk food premises”. It specifies that an employee with a valid food safety training certificate must be present at all times in high and medium risk food premises which have 3 or more employees. It is important to note, whereas the MHPSG Food Safety Program Standards have the force of law, the requirements of the protocol do not. Consequently, because the Food Safety Program Standards do not make food handler training courses mandatory, the protocol requirement regarding certified food handlers onsite in high and medium risk food premises as described above has never been enforced.

1. Outbreak Investigation

The MHPSG Food Safety Program Standards state:

7. The Board of Health shall have a written protocol for responding to food related complaints, based on a risk assessment approach, and shall take appropriate action within 24 hours of notification of the food related complaint.

All 37 health units within Ontario have defined Communicable Disease Outbreak policies and procedures, which include investigation of food-borne related illnesses. Food-borne outbreaks frequently cross agency, ministry, provincial, federal and territorial mandates. The Ontario Inter-Agency Council on Food Safety is an important vehicle for ensuring inter-agency communication and providing a forum to resolve issues related to Ontario’s food safety system. This includes outbreak or emergency response. A Memorandum of Understanding for Food-borne Illness Outbreak and Hazard Response and Product Recalls is presently being finalized to formally define areas of accountability and responsibility for the following:

(a) Canadian Food Inspection Agency;
(b) Health Canada;
(c) Ontario Ministry of Agriculture and Food;
(d) Ontario Ministry of Health and Long-Term Care;
(e) Ontario Ministry of the Environment; and
(f) Ontario Ministry of Natural Resources.

2. **Food Recall**

The current role for Ontario Public Health Units in food recall situations is defined in the document entitled Food Recall Protocol under the MHPSG Food Safety Program Standards which state:

5. *The Board of Health shall undertake Food Recalls in accordance with the Ministry of Health Food Recall Protocol (January 1st, 1998).*

The Food Recalls Protocol may be initiated by the Medical Officer of Health. This protocol directs the process to be followed in such instances, as well as for food recalls instigated by the Canadian Food Inspection Agency or the Ontario Ministry of Health and Long-Term Care.

V. **PUBLIC HEALTH INSPECTOR TRAINING**

Ontario Regulation 164/84 under the Health Protection and Promotion Act (Qualifications of Boards of Health Staff) states the following:

5. *The requirements for employment as a Public Health Inspector are that the person,*

   (a) *be the holder of a certificate granted by the Board of Certification of Public Health Inspectors of the Canadian Institute of Public Health Inspectors; or*

   (b) *is registered as a veterinarian under the Veterinarian’s Act and is the holder of a certificate in Veterinary Public Health or has experience that the Minister considers equivalent to such registration and certification; or*

   (c) *be the holder of a certificate issued prior to the 1st day of July, 1979 by the Canadian Public Health Association or by a certifying organization that is recognized by the Canadian Public Health Association.*

Currently, an individual wishing to become a public health inspector must complete a 4-year program approved by the Canadian Institute of Public Health Inspectors (CIPHI). There are 5 such programs in Canada as follows:

1. Ryerson University, Toronto, Ontario
2. British Columbia Institute of Technology, Burnaby, British Columbia
3. Concordia University College of Alberta, Edmonton, Alberta
4. University College of Cape Breton, Sydney, Nova Scotia
5. First Nations University of Canada, Regina, Saskatchewan.

In addition, candidates must complete a 12 week CIPHI authorized field placement with a recognized environmental health agency. Finally, candidates must successfully complete the CIPHI Board of Certification examination.
Public Health Inspectors do not receive as part of their university program, training in meat inspection such as slaughter technique, dressing of a carcass or signs of animal diseases. They do receive training in meat processing such as curing, smoking, sausage preparation etc., with special emphasis on spoilage and preservation of food with particular emphasis on high risk foods such as meat.

**References and Bibliography**


CHAPTER 7

THE ROLE OF SCIENCE IN MEAT INSPECTION SYSTEMS

Preceding chapters described the principal public health risks associated with meat and meat products and the methods that are used to control them. Our understanding of the nature of these risks and how best to reduce their impact on society is continuously evolving as scientific advances are made. Accordingly, government agencies should keep abreast of these developments and integrate them into their programs. In this section we review some of the ways science affects meat inspection policies and procedures. Obviously, certain elements of the scientific basis of meat inspection have been touched on in previous chapters, including the sections on surveillance, roles of laboratories, HACCP, and farm-to-fork approaches. We focus here on some of the key elements of a science-based meat inspection system, in particular on the use of risk analysis and baseline studies.

In a science-based meat inspection system the available scientific information and technology are used to identify and characterize food safety risks, and to characterize the options for reducing these risks. This does not mean that science (including social sciences such as economics) should be the only consideration in deciding which risks deserve to be acted upon, which methods are used to manage those risks, or how available resources should be allocated. There are always other important matters that weigh into policy choices, including social values, economic, and political considerations. Nevertheless, there is an expectation that the best science will be used to support food safety policy and that scientific and other considerations will be effectively communicated to those involved and affected.

I. RISK ANALYSIS AND FOOD SAFETY

Previous expert panels have argued that model food safety systems must be science-based, with a strong emphasis on risk analysis, to allow regulators, industry and other stakeholders to set priorities for resources that are based on existing data (1-3). Food safety risk management activities should address the risks deemed to have the greatest potential impact and include evaluation of prevention strategies where possible. Risk analysis provides a science-based approach to address food safety issues.

Risk analysis has only recently been developed as a formal process for public policy formation, however it is rapidly gaining acceptance as a valuable tool, especially where there are is considerable complexity or uncertainty involved and where there may be different and sometimes competing interests among affected members of society (4). Risk is the probability that an adverse event will occur, along with its impact or consequences. More specifically, risk is "the possibility of an adverse outcome, and uncertainty over the occurrence, timing or magnitude of that adverse outcome" (5). OMAF staff have recently published on the OMAF website and in the scientific literature a number of documents concerning applications of risk analysis in food safety that cover such topics as the principles of risk analysis, a general approach to quantitative microbial risk assessment, and risk assessment frameworks (6-11).

Risk analysis was first formalized by the United States National Academy of Sciences in 1983, in a publication commonly referred to as “The Red Book” (12). Risk analysis comprises risk assessment, risk management and risk communication. Risk assessment, it was argued, was a scientific assessment of
the statistical probability of occurrence of a particular risk; risk management allowed for the incorporation of non-scientific factors to reach a policy decision; and risk communication involved the communication of a policy decision.

1. Risk assessment

Some of the public health risks associated with meat can be measured directly through epidemiological studies and human health surveillance, while others are more usefully and practically measured through indirect means. As described in chapter 4, we have a foodborne disease surveillance system in Ontario that is fairly useful for identifying the extent of acute, reportable enteric illnesses, such as *Salmonella*, *E. coli* and *Campylobacter* infections. Nevertheless, there are many suspected foodborne illnesses for which no specific microbial cause is found, and the current foodborne disease surveillance systems in Canada and abroad are poorly designed for identifying chronic foodborne illnesses, such as those potentially related to chemical residues in foods. Consequently, risk assessment methods for indirect estimation of human health impact were devised.

Risk assessment seeks to describe the probability and impact of adverse health effects. In the NAS-NRC model (12), risk assessment has four components:

1. Hazard identification—the determination of whether a particular chemical is or is not causally linked to particular health effects;
2. Dose-response assessment—the determination of the relation between the magnitude of exposure and the probability of occurrence of the health effects in question;
3. Exposure assessment—the determination of the extent of human exposure before or after application of regulatory controls; and,
4. Risk characterization—the description of the nature and often the magnitude of human risk, including attendant uncertainty.

In practice, the notion that matters of science can be neatly separated from other considerations has been criticized. It has been argued that, "The current state of the art of risk assessment does not permit questions of science to be clearly separated from questions of policy. In practice, assumptions that have potential policy implications enter into risk assessment at virtually every stage of the process. The ideal of a risk assessment that is free, or nearly free, of policy considerations is beyond the realm of possibility." (5).

Recently, an integrative approach to risk analysis was proposed (13). Risk characterization was reframed from an activity that happens at the end of the risk assessment process, to a continuous, back-and-forth dialogue between risk assessors and stakeholders that allows a problem to be formulated properly, and depends on an iterative, analytic-deliberative process. A recent American report developed an integrative framework to help all types of risk managers, including government officials, private sector businesses, and individual members of the public, make good risk management decisions. The framework has six stages (figure 7.1):
2. Qualitative Vs. Quantitative Risk Assessment

Risk assessment models should seek to use available scientific information to estimate in qualitative, or preferably quantitative terms the probability and impact of adverse health effects. While quantitative estimates of risk are highly desirable, they are not often possible because of limitations in expertise, time, data and methodology. A strong research, investigative and surveillance infrastructure (e.g. foodborne disease surveillance and baseline studies of hazards in foods) is needed to provide the information which supports the risk assessment process.

When data and expertise are available, quantitative risk assessments of microbiological hazards in food can provide very valuable information for risk management. Only a few of these have been conducted around the world, and examples include *E. coli* O157:H7 in ground beef, *Salmonella* Enteritidis in eggs, *Listeria monocytogenes* in ready-to-eat meat products, and BSE in beef. An advantage of the quantitative approach is the ability to consider and compare alternative control strategies in a simulated environment (14). Further, microbial risk assessment provides a repository of knowledge describing health risk outcomes and control strategies which can be iteratively updated and adapted.

3. Risk Management

Risk management is usually the function of organizations responsible for design and implementation of risk reduction programs (e.g., meat inspection). Risk management is defined within
Codex Alimentarius, the international food standard-setting agency, as the process of weighing policy alternatives in the light of the results of risk assessment and, if required, selecting and implementing appropriate control options, including regulatory measures. Therefore, the outcome of the risk management process, as undertaken by Committees within the Codex Alimentarius system, is the development of standards, guidelines and other recommendations for food safety (15).

4. Risk Communication

Risk communication is the process of ensuring that parties with a stake in the outcomes of risk analysis have an opportunity to become informed, and provide input and critical review. In many fields, this is one of the most important and problematic areas of public policy formation. If done well, risk communication can considerably enhance the quality and eventual acceptance and impact of risk analysis, however failure to follow good risk communication principles can ruin the most well-intentioned and well-crafted policies and programs.

5. What Happens When Risk Management And Communication Are Poorly Done?

To be effective, food safety risk management must be actively reducing, and seen to be reducing, a particular risk. Those responsible must be able to effectively communicate their efforts and they must be able to prove they are actually reducing levels of risk. Otherwise, stigma is a powerful shortcut consumers may use to evaluate foodborne risks. Well-publicized outbreaks of foodborne pathogens and the furor over agricultural biotechnology are but two current examples of the interactions between science, policy and public perception. The components for managing the stigma associated with any food safety issue involve the following factors:

- effective and rapid surveillance systems;
- effective communication about the nature of risk;
- a credible, open and responsive regulatory system;
- demonstrable efforts to reduce levels of uncertainty and risk; and,
- evidence that actions match words.

Almost any type of risk issue can turn into a seemingly intractable risk controversy, and inevitably such controversies give rise to demands on governments to "do something" about controlling or eliminating the risks in question. Although the scientific description of the hazards and probabilistic risk assessments can be matters of widespread public interest, in the final analysis the competing choices among risk management options -- banning or restricting a substance, for example -- make up the contents of letters and calls to politicians. This means that the contents of effective risk communication cannot be limited to the scientific description of hazards or the risk numbers. Rather, the science should be put into a policy (action) context, which in the early stages of an emerging risk controversy might take the form of forecasting a range of policy options -- including the "do nothing" option -- and of exploring their consequences in terms of implications for economic and social interests, international developments, and obligations for environmental protection (all in the context of the risk management cycle, mentioned earlier).
6. Risk Analysis and Public Health Hazards in Meat

Risk analysis is most useful when it supports effective management of food safety problems. The following are some of the considerations, approaches and difficulties that arise in addressing meat safety issues, and that are assisted by a structured risk analysis approach.

i. Zero tolerance

One solution to public health risks in foods is to require complete elimination of the hazards, i.e. to prohibit the sale of foods containing any amount of contaminant (microbial or chemical), or at the very least to not tolerate the presence of any contamination if known to exist. This is a concept with obvious consumer appeal, as it implies a more complete level of protection. From the scientific point of view, however, there are several practical problems to the use of “zero tolerance” policies. One difficulty is that as laboratory testing capabilities improve, scientists are able to detect ever more minute quantities (e.g. parts per billion) of contaminants that have very doubtful significance to human health. Condemning food with even trivial levels of contamination could be extremely wasteful and unnecessary. Another problem relates to the statistics of sampling; important contaminants may be non-uniformly distributed within food products and testing one or two random samples may not detect the pathogen when it is in fact present in dangerous amounts – in this instance testing provides only a false sense of security. Testing the entire product would destroy it and leave nothing to sell or consume; testing only a fraction may miss important contaminants due to sampling error. For these reasons and others, most scientists do not believe that it is possible to “test out” all contaminants from the food supply, and therefore eliminate risks completely. A recent expert panel (1) stated that “…zero tolerance is a regulatory and lay concept that specifies an ideal, but that science can strive for but never meet that ideal…” They defined zero tolerance as “lay audience perception of the absence of a hazard that cannot be scientifically assured, but is operationally defined as the absence of a hazard in a specified amount of food as determined by a specific method”. In other words, this describes the situation where the presence of a hazard when found is not tolerated.

ii. Acceptable levels of risk

If food safety risks cannot be completely eliminated from foods, then it follows that there must be some sort of threshold level beyond which these risks are no longer acceptable and that some sort of intervention is required to reduce risk. The concept of acceptable levels of risk is not purely scientific and involves societal values and practical issues, such as the availability of resources to manage risk. Most regulatory agencies are reluctant to explicitly identify these levels because of the technical difficulties and political controversies involved, however they are needed to define safe levels of contaminants in foods.

iii. Concept of maximum residue levels for chemical residues in meat

Chronic, intermittent exposure to certain chemical residues in food is hypothesised to increase risk to a variety of disease outcomes, such as allergy and cancer. Foodborne disease surveillance systems are not designed to identify most of these outcomes attributable to food, therefore scientists have devised alternative means to assess and manage risks from chemical residues in foods. Using toxicological and other scientific information, efforts are made to identify an acceptable daily intake (ADI) “which, during an entire lifetime, appears to be without appreciable risk on the basis of all the known facts at the time.” (16). In some cases (e.g. veterinary drug residues) ADIs and knowledge of the likely prevalence and concentration of residues in various foods provide a basis for establishing maximum residue limits.
(MRLs). For practical purposes, an MRL is the maximum concentration of a given residue in a given food that could be consumed daily without appreciable risk of adverse effects. For some chemicals (e.g. pesticides), MRLs are based on residue levels found in field trials where the pesticides are used according to good agricultural practices, then compared with ADIs to ensure low risk. Typically, a number of numerical “safety factors” that favour public health are used in calculating ADIs and MRLs to account for scientific uncertainties, therefore MRLs are usually considered to be conservative estimates. The concept of MRLs is important because it can be used for regulatory decision making. For example, if laboratory testing shows that meat contains greater than MRL concentrations of a chemical, the meat can reasonably be condemned on public health grounds as unfit for human consumption.

In Canada, it is primarily Health Canada’s responsibility to establish MRLs in foods. In federally inspected establishments, these are enforced by CFIA, while in provincially inspected establishments in Ontario, these standards are enforced by OMAF. There is a broad international consensus on the general principles of safety assessment of chemical residues in foods. Codex Alimentarius, an agency of the World Health Organization (WHO) and the Food and Agriculture Organisations (FAO), is the international body entrusted with setting international food standards, and recommends ADIs and MRLs for various compounds to various member countries. These Codex standards are used for international trade purposes (17).

iv. Microbiological standards for meat

For microbial hazards in foods (e.g. bacteria, viruses, parasites), the concepts of ADIs and MRLs are not directly applicable, and there are fundamental differences in the scientific approaches that have evolved for development of microbial food safety standards. These differences arise largely from the fact that microbial hazards are naturally occurring in meat, and from the dynamic nature of microbial pathogens, which makes prediction of risk much more complicated, uncertain and difficult. Paradoxically, foodborne disease surveillance systems are much more capable of estimating public health impacts of microbial hazards, therefore we know that actual cases of illness and death due to these pathogens occur, and failures of risk management are more likely to result in recognised cases of illness.

Early microbial standards focussed on ready-to-eat foods, particularly those associated with outbreaks of illness (e.g. coliform standards for raw shellfish). Through outbreak investigations and epidemiological studies, we know that there is a wide variety of contributing factors to microbial foodborne illness, including among others, spread of infection among animals on-farm, contamination of primary product, mishandling of raw and cooked product, cross-contamination, and temperature abuse. These and other related factors have complicated the development of microbial food safety standards for meat products. However, the 1993 “Jack-in-the-Box” outbreak of E. coli O157:H7 from hamburgers in the northwest United States precipitated increasing interest in developing standards for raw foods of animal origin (e.g. ground beef), and a substantial number of expert scientific panels have attempted to address this area (1-3). Since then, American authorities have instituted standards for pathogen reduction in raw meat that require microbiological testing programs. In addition, sanitary standard operating procedures are required in registered establishments. These requirements affect other countries that wish to trade with the United States, therefore federally inspected establishments in Canada also abide by these standards.
For red meats and poultry there are process control criteria for generic *E. coli* and performance standards for *Salmonella*. The frequency of *E. coli* and *Salmonella* testing is based on the species and size of the establishment. The criteria for acceptable and unacceptable microbial quality are based in part on the results of baseline studies conducted in the United States in the 1990’s, and were set at levels that would allow approximately 80% of establishments to pass the criteria (1). The results of *E. coli* testing are retained by industry and it has been recently recommended that these data be collected anonymously for development of additional benchmarks (1).

In the United States, *E. coli* O157:H7 is considered an adulterant in ground beef, and therefore unacceptable (zero tolerance). Nevertheless, this standard appears not to have had an appreciable effect on reducing the rate of human illness due to this organism (1). An expert panel recently recommended that research be urgently undertaken to better define critical control points for this organism, and until these are found, that regulatory and health authorities advise the public to thoroughly cook ground beef products, and expand educational programs for food service workers and food handlers (1).

v. Use of hazard surveillance (baseline studies) of microbial and chemical contaminants in meat in Ontario

Like some other jurisdictions, OMAF has recently undertaken a number of baseline studies of microbiological hazards (pathogens and indicator organisms) in raw beef, pork and chicken, and chemical contaminants (veterinary drug residues) in raw meats from provincially inspected plants. These studies were designed to obtain epidemiologically-valid results that are representative of product from the range of provincially-inspected operations (large and small plants). Additional studies of environmental chemical residues, and microbiological quality of ready-to-eat meats are planned. The results of these studies are very valuable for a number of reasons. They provide data on the prevalence and concentration of contaminants in foods that are critical for meaningful human health risk assessment. They provide important baselines by which to measure the effectiveness of food safety programs, such as HACCP. Furthermore, they enable determination of objective standards (performance standards) against which to measure industry performance (as described above in the United States system).

7. Risk Analysis, HACCP and Meat Inspection

Meat inspection standards and practices have evolved considerably in the past century (see chapter 6). These standards have been used to define the limits of acceptable and unacceptable product for human consumption, and the practices and procedures that are used to slaughter and process meat products. For many years, elimination of diseased animals and elimination of filth and visible contamination were important performance standards. Thirty to forty years ago, concerns about chemical contamination of the environment and food led to articulation of performance standards for residues of veterinary drugs, pesticides and chemical residues in foods. More recently, in response to heightened concerns about microbial food safety, more attention has been focused on development of microbial standards for foods, and implementation of HACCP (see chapter 2).

A number of recent reports, mainly from the United States, found that current meat inspection methods did not adequately target and reduce microbial pathogens, such as *Salmonella*, on raw meat and poultry (1-3). Recommendations have been made to reduce reliance on organoleptic inspection and move to prevention-oriented systems based on public health risk. Canada and the United States have both
reformed their traditional meat inspection-only systems into risk-based systems, designed using the principles of risk analysis. The risk-based meat inspections systems in Canada and the United States are based on HACCP.

For example, the CFIA implemented the Modernized Poultry Inspection Program (MPIP) in 2001 (18). The first component of this risk-based approach is the implementation of a HACCP plan by slaughter and processing facilities. In Canada, any plant wishing to implement MPIP must first demonstrate that it has successfully implemented a HACCP system (19).

MPIP also uses new science-based inspection methods which help reduce the presence of harmful food-borne pathogens in raw poultry products that are unseen by the naked eye. This includes an ongoing statistically-based sampling of products and microbiological testing for *E. coli* and *Salmonella* and demonstrates to the CFIA that the operator's processes are under control and in compliance with pathogen reduction requirements. The MPIP program also has trained industry employees conduct all post-mortem carcass-by-carcass examinations, while government inspectors provide continuous monitoring and assessment to ensure that poultry slaughter establishments control defects and meet prescribed standards. This allows government inspectors to focus on activities that more effectively reduce hazards to human health. Similar risk-based meat inspection programs exist in the United States where they have mandated that all federally inspected facilities have implemented a HACCP plan. Ontario is also introducing HACCP into provincially-inspected facilities.

To increase effectiveness and efficiency, these HACCP-based systems are themselves based on risk assessments. For example, inspection activities and resources are allocated where the scientific risks are greater. MPIP makes use of risk-based funding principles by shifting government resources from low-risk production line activities, such as on-line carcass sorting for visible defects, to activities where there is a higher risk involved, such as verifying that establishment HACCP plans are being implemented and are effective (18).

Risk communication also has an important role along the entire process. Policy decisions to implement risk-based systems are based on consultation with key stakeholders. For example, the MPIP program was developed through consultation with the Chicken Farmers of Canada (CFC), the Canadian Turkey Marketing Agency (CTMA), the Canadian Poultry and Egg Processors Council (CPEPC), which represents 45 out of 60 federally registered poultry slaughter establishments, the Further Poultry Processors Association of Canada (FPPAC), as well as Health Canada and the Consumers' Association of Canada. Further consultations with the United States were also undertaken to explain the program and discuss equivalence.

Integrated, risk-based inspection systems are designed to ensure that money is being spent in the right place providing more consistency, both for industry and consumers across the country. The goal is to enhance consumer protection as gaps in the inspection system are eliminated and inspection resources are allocated to areas of greatest risk. With Canada’s MPIP program, a more uniform or integrated system would also make it easier to audit and assure that money is being well spent and that jurisdictions are inspecting to standards. This facilitates Canada's ability to demonstrate equivalency and meet national treatment requirements (18).
8. Human Resources and Technical Capacity

Integrating science into meat inspection and related regulatory programs requires adequate human resources and technical capacity. Trained scientists support food safety efforts within several Ontario ministries and public health units, and provide expertise that spans the farm-to-fork continuum. Experts in food animal production, meat inspection, slaughter and meat processing are concentrated in the Ontario Ministry of Agriculture and Food. Foodborne disease surveillance and laboratory diagnostic experts are located within the Ontario Ministry of Health and Long-Term Care. Several public health units have additional scientific support in foodborne disease epidemiology. In other chapters we review human resources devoted to inspection, but this section pertains mainly to scientists that support policy formulation, regulatory programs and other activities related to inspection.

OMAF has a number of sections that contribute to the science base of their food safety programs, including the Science and Advisory Unit, the Food Safety Science Unit, Epidemiology and Risk Assessment, and on-farm food safety activities within the Agriculture and Rural Division. These units provide important scientific information, analysis, and expertise to support the ministry’s food safety activities.

The Science and Advisory Unit provides scientific, information management and compliance support to Food Inspection Branch programs, and advisory services on food safety issues and intervention programs to internal and external clients, such as food industry associations. Their activities include: designing laboratory testing programs; preparing sampling plans; analyzing laboratory data; providing technical expertise on food safety/technical issues to program staff and to industry as required; conducting literature searches; assessing risks; developing, designing, and implementing baseline study strategies for each commodity area; analyzing and interpreting results from food safety sampling and testing; enforcing scientific rigor in policy decisions and writing reports. The unit includes a manager, an information management coordinator, food scientists in the meat and dairy areas, two HACCP food safety advisors, two compliance and advisory officers, a database administrator and data scientist, and three technical support personnel.

The Food Safety Science Unit provides scientific review, information analysis, survey design and risk assessments in support of commodity- and discipline-specific specialists in other units. Its objectives are to develop and conduct risk assessments; clarify food safety issues; identify monitoring and research needs; develop survey design and provide scientific review of surveys; collect, analyze, and interpret scientific data; advise on policy; and recommend risk management options. They provide overall qualitative and semi-quantitative, ranked, assessments of food safety risks in Ontario, with broad recommendations to support the further development and implementation of effective and efficient risk control programs. They determine the prioritization of risks to food safety, backed up with surveillance data from Ontario, which is essential for the design of regulatory programs. The unit includes four analysts that address microbial and chemical food safety issues and food safety surveillance.

The Ministry also has an epidemiology and risk assessment expert who provides advice on food safety matters. The Agriculture and Rural Division is responsible for on-farm food safety matters and includes scientists that provide important expertise for development of on-farm food safety programs. The Ministry has developed a number of very high-quality approaches to risk analysis and risk management,
and as mentioned above, has published them in a series of reports (6-11). These approaches are consistent with the principles of good risk analysis and are of international quality.

References and Bibliography


CHAPTER 8

BSE AND *E. coli O157:*H7 - ROLES AND CAPABILITIES OF MEAT INSPECTION REGIMES IN ONTARIO

In preceding chapters we addressed the general characteristics of public health risks from meat and meat products, the various parts in the farm-to-fork continuum, and the components of public and private sector systems for characterizing and managing these risks. Food safety is a very large and complex topic and it is beyond the scope of this report to present in detail the specific scientific and regulatory considerations for the complete range of public health hazards in meat. Nevertheless, we believe that presentation of two examples of food safety issues, BSE and *Escherichia coli O157:*H7, would be useful for a more focussed, integrated, and hazard-specific examination of the capabilities of meat inspection regimes in Ontario. Even these examples, however, will necessarily be brief overviews; there are books and many thousands of scientific and regulatory articles written on each of these subjects.

Bovine Spongiform Encephalopathy was selected as the first example because its recent discovery in Canada has had profound effects on meat inspection systems, the cattle industry, and the national economy. Bovine Spongiform Encephalopathy and its implications to meat safety are also of considerable interest to consumers. Federal agencies have principal responsibility for many of the control actions for BSE, however there are still important provincial roles and responsibilities. *Escherichia coli O157:*H7 was selected for the second example because it is an important foodborne disease in Ontario, it is well known to consumers as the principal disease-causing agent in the Walkerton tragedy of May 2000, and its control involves a broad spectrum of parties in the farm-to-fork continuum, including consumers.

Bovine Spongiform Encephalopathy is an example of a hazard that may be present within certain tissues of live animals, but does not appear to multiply in foods post harvest. Certain parasitic and chemical residue hazards also behave in this manner. In contrast, *E. coli O157:*H7 can enter at many other levels of the food chain, is a much more dynamic pathogen, and can under certain circumstances multiply in foods. These features and others have significant implications for the control options available, and demonstrate that different types of controls at different levels of the farm-to-fork continuum may be appropriate for different types of hazards. Table 8.1 shows the range of possible BSE and *E. coli O157:*H7 control methods that may be used on the farm, and at various other levels in the farm-to-fork continuum. These are addressed in more detail in the sections below.

I. BSE

Bovine spongiform encephalopathy (BSE), also known as “mad cow disease” was first diagnosed in the U.K. in 1986 and has since been diagnosed in 21 other countries. It is believed that all cases are linked to the original epidemic in the U.K., and that the disease spread to other countries through international trade in contaminated meat and bone meal, and in live cattle (1). The first Canadian case was diagnosed in a cow in 1993. This animal was imported from the U.K., where it is believed to have contracted the infection (many scientists believe that BSE is not a true infection but because it behaves like one epidemiologically, we will refer to it in those terms for simplicity). The second Canadian case
was diagnosed in Alberta in May 2003 in a downer cow. The owner had sent the animal to a provincially inspected abattoir in order to try and salvage meat for his own use. The cow was condemned on ante-mortem inspection because of severe pneumonia. It did not enter the food chain but was tested for BSE under a routine surveillance program. This animal was born in Saskatchewan and spent its entire life in Canada - therefore this was the first *indigenous* case of BSE in the country (2).

In December, 2003, another North American case was discovered in Washington State, U.S.A., although investigations later demonstrated that this animal was born in Alberta and may have contracted the disease in Canada (3). Both of the affected animals were born prior to the 1997 national ban on feeding ruminant-derived protein to ruminants (cattle, sheep, deer, etc.), therefore they may have consumed BSE-contaminated feed. Following the discovery of the Canadian case, intensive trace-back and trace-forward investigations led to the slaughter and testing of more than 2,000 animals, but no additional cases were found (4). Nevertheless, it is possible that additional cases will be found in Canada.

### Table 8.1. Demonstrated and potential farm-to-fork controls for BSE and *E. coli* O157:H7

<table>
<thead>
<tr>
<th>Level of Farm-to-Fork Continuum And Type of Control</th>
<th>Example Control Steps</th>
<th>BSE</th>
<th>E. coli O157:H7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>International / National / Provincial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Import Controls</td>
<td>Federal restrictions on importation of animals and animal products from countries at risk</td>
<td></td>
<td>Not applicable for livestock</td>
</tr>
<tr>
<td>Feed Safety</td>
<td>National ban on feeding ruminant-derived meat and bone meal to ruminants</td>
<td></td>
<td>No specific evidence-based controls at present. Some prospects at research stage</td>
</tr>
</tbody>
</table>
| Surveillance                                      | 1. BSE is a reportable disease  
2. Surveillance of livestock population (e.g. testing brains of diseased, non-diseased animals) for risk assessment  
3. Surveillance of prion-related neurological disease in humans  
4. Product and animal tracking at all levels of the F-F continuum (e.g. Canadian Cattle Identification Program) | | 1. Hazard surveillance in various foods for risk assessment  
2. Surveillance of associated illness in humans (bloody diarrhea, HUS)  
3. Product and animal tracking at all levels of the F-F continuum |
| **Farm Level**                                    |                       |     |                 |
| Herd Biosecurity                                  | Animal purchases from known sources and ensure properly tagged and identified | | Not applicable – endemic on cattle and perhaps sheep farms |
| Herd Health Programs                              | Routine measures not generally applicable in Canada. No credible live animal BSE test yet available. No therapy or vaccine | | Not applicable – no disease problems in livestock. Testing of live animals of no practical benefit. |
| Good Animal Production Practices                  | 1. Prevent cross-contamination with pig or poultry feeds  
2. On-farm food safety program | | No specific interventions yet proven. Promising research on vaccines, probiotics, feed additives. Possible benefits from water, feed hygiene. |
| **Slaughter Level Meat Processing**               |                       |     |                 |
| Ante-mortem Inspection                            | Detection of suspect animals (e.g. neurological disease, recumbency) for exclusion from food chain and for laboratory testing | | No specific evidence-based controls at present |
| Post Mortem Inspection                            | Removal of specified risk materials (e.g. brain, spinal cord, certain other tissues) from cattle | | No lesions of disease in infected animals |
| Slaughter Hygiene                                 | Prevention of cross contamination from specified risk materials (e.g. saws, knives, mechanically recovered meat) | | 1. Prevention / trimming of fecal contamination  
2. Surface decontamination with various rinses, steam, hot water pasteurization  
3. HACCP-based food safety programs  
4. Training |

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<table>
<thead>
<tr>
<th>Level of Farm-to-Fork Continuum And Type of Control</th>
<th>Example Control Steps</th>
<th>E. coli O157:H7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat Processing</td>
<td>Prevention of cross contamination from specified risk materials (e.g. saws, knives, mechanically recovered meat)</td>
<td>1. Kill step (e.g. cooking)</td>
</tr>
<tr>
<td>Distribution, Retail, Food Service / Home</td>
<td>Not applicable</td>
<td>2. Fermentation / additives / drying</td>
</tr>
<tr>
<td>Food Service</td>
<td>Not applicable</td>
<td>3. Prevention of contamination / recontamination (e.g. packaging)</td>
</tr>
<tr>
<td>Home</td>
<td>Not applicable</td>
<td>4. Chilling / freezing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Food handler training</td>
</tr>
</tbody>
</table>

\(a\) HACCP and product tracking systems applicable at all levels
\(b\) BSE is an example of a food safety agent or hazard introduced in live animals but not known to significantly grow/die during processing, cooking, storage, etc.
\(c\) E. coli O157:H7 is an example of a food safety agent or hazard that may be introduced at multiple levels of the food chain and may grow/die during processing, cooking, storage, etc.

The following is a brief summary of the disease, its public health implications, and methods of control by government and other agencies, with special focus on the situation in Ontario. More comprehensive scientific descriptions, risk assessments, and management plans from Canada, the United Kingdom, and the United States are available elsewhere (5-7).

1. **Summary Of The Disease In Cattle And Public Health Threat To Humans**

Bovine Spongiform Encephalopathy is a fatal brain disease of cattle that is one of a group of diseases of animals and humans called transmissible spongiform encephalopathies (TSEs). Examples of other TSEs include scrapie in sheep, Chronic Wasting Disease in deer and elk, and Creutzfeldt-Jakob Disease in humans. Most scientists believe that the causal agent of BSE is an abnormal infective form of protein (prion) that accumulates in brain cells (neurons), interferes with cell function and eventually leads to death of the animal (5). These abnormal prions are very resistant to heat, radiation and chemical disinfectants. The principal means of infection of cattle is the feeding of ruminant-derived protein supplements (meat and bone meal) containing the BSE agent, although there is some evidence that in rare cases there may be transmission from an infected cow to her calf (vertical transmission), but this is not thought to be sufficient to sustain infection in a population of cattle. Bovine Spongiform Encephalopathy does not spread horizontally, i.e. directly from animal-to-animal, which is important for disease control. The time interval from infection to the onset of clinical signs (the incubation period) is quite long, averaging 3-6 years (8). Veterinarians can make tentative diagnoses in live animals based on typical clinical signs, however there are no validated laboratory tests for use in live animals. After death, diagnosis is based on one or more laboratory tests on brain tissue.

Experimental studies have shown that certain tissues of cattle with BSE may contain infective material. These are called Specified Risk Materials (SRMs) and by international consensus include the skull, brain, trigeminal ganglia, eyes, tonsils, spinal cord and dorsal root ganglia of cattle over 30 months
of age (OTM), and the distal ileum of cattle of all ages (9). The OTM classification is based on the extremely rare incidence of BSE in cattle less than 30 months of age; a function of the very long incubation period of the disease (10). Scientific evidence suggests that over 99% of infectivity is removed by removal of SRM from cattle with BSE. Therefore, after effective SRM removal, other tissues and products from BSE-affected cattle (e.g. muscle tissue, milk, gelatine) are for practical purposes free of the infective agent and therefore do not pose an appreciable health risk to other cattle or to humans (9).

Creutzfeldt-Jakob disease (CJD) is a human TSE. It is rare and always fatal and occurs in classical and variant forms. The classical form usually occurs spontaneously, although some cases occur in people with genetic predispositions, or accidentally as a result of certain medical procedures. The variant form (variant CJD) is linked to consumption of contaminated beef from cattle with BSE (9). The incubation period is believed to be at least 10 to 15 years. Variant CJD was first diagnosed in the U.K. in 1996 and since then a total of 134 cases have been diagnosed, mainly in the U.K. and other European countries. One case has been detected so far in Canada, although it is believed that this person was exposed in the U.K (11).

2. Federal Responsibilities And Capabilities

The Canadian Food Inspection Agency (CFIA) has the major responsibilities for the enforcement and administration of federal legislation aimed at food safety and animal health (and therefore BSE) in Canada. Broadly speaking, CFIA efforts related to BSE focus on regulation of imports, rendering and feedstuffs, slaughter, surveillance and cattle identification, and reportable disease detection and control. Legislative authority is provided by the Health of Animals Act, Meat Inspection Act (Canada), Feeds Act, Agriculture and Agri-Food Administrative Monetary Penalties Act, and respective regulations. CFIA also has risk assessment capability and published a detailed assessment of BSE risks in 2002 (5).

i. Import regulation

Prior to May 2003, BSE was considered a foreign animal disease, therefore there was (and still is) critical importance assigned to preventing the importation of BSE through infected animals or contaminated products, such as meat, meat by-products, feed and feed ingredients, and other products and commodities. In 1990, Canada imposed an import ban on cattle from the U.K, and later on cattle from other affected countries. Since December 31, 1996, Canada has prohibited the importation of cattle and bovine products from countries not recognised free of BSE (5). A risk assessment has shown that since 1978, meat and bone meal has not been imported from the U. K. or from any other countries subsequently affected by BSE, therefore BSE is unlikely to have been imported in these products (5). However, cattle imported in the 1980s from the U.K. and other affected countries were at risk of disease, and given the long incubation period of the disease, one or more of these animals could have introduced BSE into the country before import restrictions were imposed. Therefore, efforts were made by CFIA to trace these animals and monitor or quarantine those still alive, and determine the fate of those that died or were slaughtered. In 1994, following detection of the imported case, all remaining cattle imported from the U.K between 1982-1989 were killed and none showed evidence of BSE. Records and trace-back investigations show that from 1982 to 1990, 182 cattle were imported from the U.K. and 68 of these were potentially rendered into meat and bone meal. Most came from British farms that had not reported any cases of BSE, however 10 of these cattle came from farms known to have had at least one case (5). Therefore, it seems likely that one or more of these animals introduced BSE into Canada, were
subsequently rendered, and that there was some contamination of feed resulting in at least the one case detected in Alberta in May 2003, and another in Washington State in December 2003. If this hypothesis is true, other cases may emerge.

ii. Slaughter

Most Canadian cattle are slaughtered in federally registered establishments. The critical BSE controls at slaughter currently include ante-mortem inspection and removal of Specified Risk Materials (SRMs). Ante-mortem inspection has been in place for decades and is conducted in two steps. The first step is screening by a trained plant employee to identify and segregate abnormal animals; in addition, an inspector examines normal animals at rest. The second step consists of a veterinary examination of segregated animals. Based on this examination, the veterinarian makes a diagnosis and determines whether the animal should be condemned or slaughtered, and if slaughtered, the carcass is subjected to post-mortem examination by a veterinarian. Animals with evidence of central nervous system disease on ante-mortem inspection are condemned (12). Inspectors and veterinarians have been trained in detection of BSE and other neurological diseases of cattle on ante-mortem examination. Animals considered BSE suspects must be reported, their brains submitted for laboratory testing, and the carcasses destroyed by incineration or burial (5). Brains from animals condemned for other diseases may also be selected for surveillance testing (see below) and the carcass is held pending test results or sent for rendering as prohibited raw material that does not enter the human or ruminant food chain.

Laboratory BSE testing of animals for inspection purposes, i.e. determining the acceptability of animals for human consumption, is currently conducted by some countries. Based on a historically higher incidence of BSE, the U.K. and other European countries test the brains of all slaughter cattle over 30 months of age (OTM), brains of higher risk animals at 24 months, and condemn all positives (13,14). Japan has had a few cases of BSE in recent years and is currently testing all slaughter cattle prior to acceptance for human food. Canada and the United States do not currently use BSE testing of cattle for routine inspection purposes. North American regulatory authorities contend that the extremely low prevalence of BSE in the cattle population, and provisions for ante-mortem inspection and SRM removal make this type of testing unnecessary to ensure food safety (15). We agree with that conclusion. Despite this scientific rational, testing may be deemed necessary in some instances to satisfy consumer confidence and protect market access. These issues are discussed further in chapter 9.

Since July 2003, federal authorities require that plant operators identify OTM cattle and remove the SRM from the carcasses, and remove the small intestine from cattle of all ages. Specified Risk Materials are considered inedible meat products and currently may be directed to rendering of ingredients for feeds of non-ruminant animals. Operators are also required to develop and implement control programs (e.g. HACCP-based food safety programs) to support this policy, with verification by inspectors (5). Controls include prevention of contamination of carcasses with SRM (e.g. by excluding certain raw materials from mechanical meat recovery procedures), and prohibition of air-injection stunning or other factors that could contribute to carcass contamination. Currently, classification of animals aged 30 months or older is based on dentition (12). Effective removal of SRM is important for food safety because infective material may be present in SRM from cattle in the late stages of BSE incubation; this could occur just prior to development of clinical signs that would otherwise enable detection of affected cattle at
ante-mortem inspection. As an additional quality assurance practice, at least some establishments are only processing animals or beef from animals born after the 1997 ruminant feed ban.

Non-ambulatory cattle (downers) are recognised to be at higher risk of BSE than ambulatory cattle, and the two recent North American cases were apparently both downers, but the Alberta case was condemned for pneumonia on ante-mortem inspection. In January 2004, U.S. authorities banned downers from the human food supply on this basis, and the CFIA recently advised registered establishments to stop accepting downers in order to be eligible for export of beef to the U.S. (16). In the U.K., beef from OTM cattle has for several years been excluded from the human food chain, however in view of the declining incidence of BSE, British authorities have recently recommended the resumption of use of this meat for human consumption. In the case of “casualties” (including disabled or non-ambulatory stock), they have recommended acceptance for human food following inspection and BSE testing (13). We consider that BSE-related public health risks posed by beef from downers is extremely small provided that proper inspection procedures, based on objective criteria designed to keep BSE-affected cattle out of the food chain, are followed and SRM removal is ensured. The possible role of BSE testing or other measures in relation to downers is addressed further in chapter 9.

iii. Rendering and feedstuffs

Rendering facilities process inedible animal by-products (e.g. offal, bones, feathers, SRM, dead stock) and produce animal-derived protein (meat and bone meal; MBM) for use in livestock feeds. In August 1997, Canada implemented a ruminant-to-ruminant feed ban, therefore ruminant-derived meat and bone meal is considered prohibited material and may not be fed to ruminants. However, porcine and equine proteins or proteins from milk and blood of all animals may still be fed to ruminants (5). A variety of processes are used for rendering (see chapter 2), although none that is currently used completely inactivates the BSE agent. Control of BSE risk at the rendering level depends on exclusion of ruminant-derived protein from ruminant feed. Since 1997, renderers must clearly identify prohibited material and include the following statement on labels: “Do not feed to cattle, sheep, deer or other ruminants”. In facilities that produce both prohibited and non-prohibited materials, steps must be taken to reduce the likelihood of cross-contamination, including separate lines of operation, or flushing and sequencing procedures (17). Most rendering operations operate under a quality assurance program and some have implemented HACCP – based food safety programs.

CFIA also regulates the manufacture, sale and importation of livestock feed in Canada. The main BSE regulatory control at this level is achieving compliance with the prohibition of ruminant-origin MBM in ruminant feeds. Risk reduction strategies in mills that produce feed for ruminants and non-ruminants include a variety of manufacturing practices to keep these feeds separate and avoid cross-contamination. Approved animal-derived protein is used more commonly in dairy cattle than beef cattle. Farmers who feed both ruminants and non-ruminants on the same farm and purchase feeds containing prohibited material for feeding the non-ruminant species (e.g. pigs or poultry), must keep accurate records and invoices for two years (17). Farmers, feed manufacturers and renderers are required to take steps to avoid cross contamination by providing clear labelling, separate storage and dedicated equipment, or by thoroughly cleaning non-dedicated equipment.

European countries have banned the use of all meat and bone meal in food animal feeds (14). Consideration has recently been given to modifying feed control measures in Canada in light of the
discovery of indigenous BSE. At least three options have been discussed and include: increased inspection and dedicated lines / facilities to keep ruminant-derived meat and bone meal out of ruminant feeds; removal of SRM and dead stock; and removal of all ruminant meat and bone meal from the animal feed chain (18).

We believe that to control the spread of BSE through feed, it is critical to keep all ruminant-derived meat and bone meal out of ruminant feeds. The best means to achieve that goal is still the subject of discussion by CFIA and stakeholders.

iv. Surveillance and animal identification

Bovine Spongiform Encephalopathy was made a reportable disease in 1990, which means that veterinarians or others that suspect a case must report it to federal authorities. In 1992, CFIA in conjunction with the provinces initiated active surveillance for BSE based on collection and laboratory testing of brains from various populations of cattle from across the country (19). Until 2003, the main purpose of surveillance was to determine whether or not BSE existed in Canada. Since the discovery of indigenous BSE in 2003, there is intent to undertake more intensive testing. Surveillance is focussed on high-risk populations (dead, dying, disabled and diseased animals). These include cattle with neurological disease detected in abattoirs, veterinary diagnostic laboratories or by private veterinarians, plus downers and dead stock, and animals subject to emergency slaughter (e.g. injuries). As of 2004, approximately 10,000 brains from various regions of the country have been examined for BSE using histopathology or immunohistochemistry, and one positive has been found (the May 2003 case from Alberta). There are international standards for BSE surveillance, and Canada has exceeded these each year since 1993, with the exception in 1995. CFIA plans to enhance its surveillance by increasing the numbers of animals tested, in conjunction with the provincial authorities who also conduct some BSE testing (19).

Partly in response to the 1993 case and to recognised deficiencies in animal tracking, the Canadian Cattle Identification Program (CCIP) was developed to make it possible to trace individual animal movements from the herd of origin to slaughter. The program has been mandatory since 2002, and requires that before leaving the birth herd, ear tags be applied bearing numbers unique to each animal (5). Tags are then collected at the time of slaughter or death. The data are stored in a national data repository by the Canadian Cattle Information Agency and are available to CFIA for tracking, however the current system has to be perfected for better tracking of farm-to-farm movements.

v. CJD surveillance

Creutzfeldt-Jakob Disease (CJD) is a notifiable disease in Canada. In 1998, Health Canada initiated a surveillance system for CJD (including variant CJD), which is based on a national network of infectious disease physicians, neurologists, neuropathologists, and others. Through interviews, reviews of medical records, and laboratory testing, the surveillance program provides support for CJD diagnosis, and disseminates surveillance information to physicians and the public (20).

3. Provincial Responsibilities And Capabilities

While federal authorities have the principal responsibilities for BSE control, and exclusive responsibility for import and feed regulation, there are also important provincial responsibilities for inspection of animals and meat, surveillance, on-farm food safety program enhancement, and extension. For example, Canada’s only indigenous BSE case was detected by the Alberta provincial meat inspection
and surveillance system. It is also critical that federal and provincial authorities cooperate and communicate on BSE control measures.

i. Slaughter

Provincial activities and responsibilities in this area are broadly similar to those described above for federal establishments, however there are some differences in ante-mortem inspection and requirements for HACCP-like programs. As described in chapter 6, ante-mortem and post-mortem inspection procedures and dispositions in provincially inspected abattoirs in Ontario are similar to those in federal establishments, except that a veterinarian is not on-site for routine animal slaughter. OMAF staff veterinarians are available by telephone for inspector-veterinary discussions which involve both the ante-mortem and post-mortem observations on suspect animals during all slaughter periods. If necessary, an appointed practicing veterinarian is called in to assess the living animal or to conduct a post-mortem examination of a slaughtered animal (whichever situation applies). In the case of downers, a practicing veterinarian must examine the animal on farm and complete a certificate that provides some relevant information to the inspector at the abattoir, so this provides an additional opportunity for detection of animals showing signs consistent with BSE. In fact, a practicing veterinarian that suspected BSE in a downer or any other animal is obliged by law to report the case to federal authorities, and the animal would not be allowed to leave the farm. As in federal establishments, provincial inspectors have been trained in detection of BSE suspects on ante-mortem inspection, and removal of SRM from carcasses (21). Policies and procedures for identification of OTM cattle and SRM removal are the same as those applicable in federal establishments as described above, and were implemented in July, 2003. Operators are responsible for developing, implementing and maintaining documented control programs, and for monitoring and record keeping of these programs. These should be part of the HACCP-based food safety program. Inspectors verify the accuracy of the OTM age classification and proper SRM removal, and compliance with SRM removal procedures is part of the audit program of provincially inspected abattoirs (21).

While BSE controls in provincially inspected abattoirs do not appear to differ qualitatively from those currently applied in federal establishments, there are some differences in the cattle populations, particularly with regard to downers, but also in the proportion of cows slaughtered compared to younger animals. These differences are expanding due to border restrictions, and especially since federal establishments are more likely to refuse downers in order to comply with U.S. regulations, so that more downers are ending up at the provincial abattoirs. Because of their high-risk status, downers warrant more careful ante-mortem examination, condemnation if any signs of central nervous system illness are present, and rigorous compliance with SRM removal requirements in provincially inspected abattoirs. These matters are discussed further in chapter 9.

ii. Surveillance

Ontario is a major participant in the national BSE surveillance program by conducting its own sampling and testing program, and by providing brain specimens for testing in federal laboratories. There are two components to the program: laboratory surveillance and targeted surveillance. All testing is conducted by the Animal Health Laboratory (AHL), University of Guelph (22), although any specimens producing positive or suspicious test results would be forwarded to CFIA for further testing because the disease is reportable to federal authorities. For the laboratory surveillance component, brains of cattle
with and without clinical signs of neurological disease submitted to the AHL are tested histologically (microscopic sections) by veterinary pathologists. In 2003, for example, brains of 34 animals with neurological signs and 98 without such signs were examined and no evidence of BSE was found. In the targeted surveillance program, which began in 2002, brain samples are collected from high-risk populations, including downers, emergency slaughter and condemned animals. Since 2003, samples from dead stock are also collected. Up to the end of 2003, 1,680 abattoir and deadstock specimens were tested by the immunohistochemistry method and no positives were found (22). This level of surveillance represents approximately 1/3 of BSE testing in Canada, while Ontario has approximately 15% of the national herd. Therefore, Ontario is making a major contribution to the national surveillance program.

iii. Dead stock and extension

Ontario's Dead Animal Disposal Act (DADA) is designed to keep dead stock, including any animals that might die from BSE, out of the food chain. This includes requirements for burial, composting or collection by a licensed dead stock collector.

OMAF has provided written information to producers on BSE prevention, which includes descriptions of the disease and its public health importance, and recommendations for control. In addition to the initiatives described below, producers are urged to comply with federal disease reporting and feed regulations, to comply with the section of the Dead Animal Disposal Act pertaining to transport of dead livestock, to routinely consult with veterinarians on animal health matters, and to provide animals for post mortem examination by veterinarians (23). OMAF has also begun to contribute to on-farm food safety programs (24).

iv. Private sector initiatives

BSE controls at the farm level focus on herd biosecurity (e.g. purchase of animals from known sources), proper tagging for identification, disease reporting, record keeping and feed quality assurance. Farmers are legally required to report suspected cases to federal authorities, although there are concerns that the severity of impact on the industry could discourage reporting. The potential for feeding prohibited materials to ruminants is higher on farms that have both ruminants and non-ruminants, and farmers are urged to take preventive steps (e.g. following label instructions on feed bags) and to keep invoices and other records of feeds used (23).

Practicing veterinarians are an important capability for BSE control through diagnosis and control of clinical diseases on farms, and through provision of advice for disease prevention. In 2003 there were 691 veterinarians registered as working in livestock medicine in the province, however not all of these would be working on cattle farms. Veterinarians are also legally required to report suspect cases of BSE to federal authorities (25).

The dead stock industry is an important source of samples for BSE surveillance. Involvement in this program has important implications for the industry, including the disposition of carcasses pending results of BSE testing. Many in the industry do not have storage facilities to cope with the at least 96 hr turn around time for test results, and the implications associated with possible recalls of product discourage participation.

v. CJD surveillance
All transmissible spongiform encephalopathies of humans, including CJD, are reportable in Ontario. While Ontario does not have its own CJD surveillance program, it participates in the national program (described above).

vi. Further processing, retail, foodservice, foodhandling

After carcasses have been inspected, and the SRM are removed, the meat is taken for further processing, cutting and grinding for distribution or sale. Aside from the general applicability of product tracking capabilities at various levels of the food chain to permit recall or tracing, there are no specific measures at the further processing, retail, food service or consumer level that are appropriate for BSE control. The infective agent is not detectable in meat once specified risk materials have been removed. Even if present, the agent is not materially affected by processing, storage, handling or cooking. Therefore controls must be applied at the slaughter and primary processing levels. There is one possible exception in Ontario, at least for a few more months. Currently, uninspected carcasses (which may or may not have had SRM removed) for personal use may be brought into butcher shops for cutting. Public health inspectors are currently providing information to proprietors and requesting notification when OTM cattle are butchered for someone’s own use. This situation will, however cease as of September 1, 2004, as amendments were recently made to the Health Protection and Promotion Act Food Premises regulation to prohibit uninspected meat in shops.

vii. Overall analysis of provincial capabilities for BSE control

Ontario makes a substantial and appropriate contribution to BSE control in Canada. Important public sector functions include inspection at slaughter, surveillance, active participation in federal programs and surveillance, and extension. Many of these functions are collaborative in nature and carried out with federal and private sector partners, and so far as we can tell, it appears that there is good cooperation and communication among these partners. Within the scope of provincial responsibility, the most critical activities include the provision of effective ante-mortem inspection, effective SRM removal from carcasses at provincially inspected abattoirs, and surveillance. Provided that compliance with existing regulations and policies is achieved, these provincial capabilities are adequate at the present time. Improvements recommended in chapter 9 should enhance these capabilities.

II. E. COLI O157:H7

Since the early 1980’s, *E. coli* O157:H7 has been recognized as a major cause of food and waterborne illnesses in Canada and many other countries around the world (26). First identified in association with consumption of undercooked hamburgers, more recent epidemiological investigations have linked human illness to a wide range of foods and other sources, including water (27, 28). For many Canadians, the May 2000 waterborne outbreak in the town of Walkerton highlighted the public health threat posed by this organism (29). Unlike BSE, control of *E. coli* O157:H7 is not principally a federal responsibility, nor for that matter is it primarily provincial or local. Control of this pathogen truly involves the farm-to-fork spectrum, and virtually all agencies and stakeholders involved in provision of safe meat and meat products have roles to play. Likewise, consumers also bear some responsibility through safe food handling.
In keeping with the format used for BSE, the following is a brief summary of the infection, its public health implications, and methods of control by government and other agencies, with special focus on the Ontario situation. More comprehensive scientific descriptions, risk assessments, and management plans from the United Kingdom, Europe and the United States are available elsewhere (30-32).

1. Summary Of The Infection In Livestock And Public Health Threat To Humans

*Escherichia coli* are bacteria found in all regions of the world, and are normal inhabitants of the gastrointestinal tract of mammals and birds. There are many different types of *E. coli*, including those that are pathogens to animals or humans, those that may under certain conditions cause illness (e.g. opportunistic infection), and those that are completely harmless. *Escherichia coli* O157:H7 is the most well-known member of a group that is characterized by the ability to produce a certain type of toxin, called verotoxin, therefore this group is often called verotoxin-producing *E. coli* (VTEC), although other names are also used (27). *Escherichia coli* O157:H7 have been reported from many countries all over the world, but Canada and certain other temperate countries, for example the U.S. and the U.K., seem to have greater problems with the infection (27, 28, 30).

Cattle are believed to be the primary reservoir of *E. coli* O157:H7, though other ruminants including sheep, goats and deer may also be sources (31, 33). Under normal circumstances, animals are not affected by infection and show no clinical signs. Various studies have shown that the prevalence of *E. coli* O157:H7 in beef and dairy cattle on farms ranges from 0% to 68%, and the herd prevalence from 1.8% to approaching 100% with a wide distribution (34-36). Shedding of *E. coli* O157:H7 is usually transient, and after clearing infections, animals may again become infected at a later date. On infected farms, peak shedding occurs in summer and early fall, but the infection is usually at a low level or often not detected in the winter months (30). The bacteria are shed in the feces of infected cattle, however the bacterium may also be present within the animals’ mouths, and on their hides (31, 35).

Cattle and other ruminants have been implicated as the source of this organism in outbreaks of disease involving foods such as ground beef, sausage, milk, apple juice, lettuce, and sprouts (37). The bacteria are killed at normal cooking temperatures (68.3°C/155°F for ground meats/hamburger) but show some acid resistance, which has implications to some types of meat preservation (e.g. salami) (31). Livestock have also been identified as the source in outbreaks associated with drinking and recreational water, and are believed to be the source in many cases of infection from contact with infected animals (38, 39). Other sources of infection include person-to-person spread in day care centres and swimming pools (40).

Illness in humans due to *E. coli* O157:H7 can involve the gastrointestinal tract, kidneys or other organs resulting in diarrhea, bloody diarrhea, kidney failure and in some cases, death (27, 28). Between 300-600 human cases of illness due to this organism are reported annually in Ontario, and between 1200-1700 in Canada (41). It is known, however, that many cases go unreported. An Ontario study demonstrated that 4-8 symptomatic cases may exist in the community for every reported case (42). Children under 5 years of age are at increased risk, and *E. coli* O157:H7 is a common cause of hemolytic uremic syndrome (a life-threatening kidney disease) in children (27, 28). The hospitalization rate in Canada for 1995 was 365 per 1000 cases, with a case fatality rate of 39 per 1000 cases (42).
In addition to the public health impact, there are important impacts of this organism on industry, including expensive product recalls when food supplies become contaminated.

2. Federal Responsibilities And Capabilities

The major federal responsibilities for \emph{E. coli} O157:H7 control in meat pertain to setting national policies and standards, inspecting federally registered establishments, including those conducting slaughter and meat processing, managing Canada’s Food Safety and Enhancement Program (FSEP), which is a program for the implementation and oversight of HACCP in federally registered establishments, and, when necessary, oversight of recalls of contaminated and potentially contaminated foods. Health Canada establishes policies and standards for the \emph{E. coli}-related safety of food sold in Canada, and carries out food-borne disease surveillance. These policies and standards are enforced by the Canadian Food Inspection Agency (CFIA). Health Canada also has responsibilities for risk assessment, and has published a comprehensive assessment of \emph{E. coli} O157:H7 from ground beef (43).

Regulation of animal and animal product importation, rendering and feed regulation, which fall under federal responsibility and are so important for BSE control, have comparatively little direct relevance for \emph{E. coli} O157:H7, because the infection is already endemic and widespread in Canada, and feed has not been shown to be an important vehicle of transmission among livestock populations. However, general federal responsibilities concerning the microbiological safety of imported foods would apply indirectly to the \emph{E. coli} O157:H7 hazard.

It is beyond the scope of this brief case study to review all of the activities that pertain directly or indirectly to control of \emph{E. coli} O157:H7. The following is a very brief overview.

i. Slaughter and meat processing

This is an important area for control and efforts focus on the prevention of microbial (including \emph{E. coli} O157:H7) contamination of meat, removal of contaminants, limiting their growth in meats, or, where possible, killing of these microbial contaminants. Important regulations for prevention of contamination include, among others, those governing proper sanitation of facilities, equipment, and food contact surfaces, proper use of sanitizers, techniques for carcass dressing (e.g. hide and viscera removal), proper use of hand washing, and sanitizing of knives (12, 30, 31). Examples of interventions for removal of microbial contamination include requirements and conditions for trimming of visible fecal contamination, and use of steam and hot water treatments (e.g. carcass “pasteurization” to kill surface contaminants), spray rinses (with or without added chemicals such as organic acids) and rapid chilling. Many establishments use several of these interventions in their process to enhance effectiveness. Proper refrigeration, drying, smoking, fermentation, use of certain additives, or some combination of these are also used to control the growth of \emph{E. coli} O157:H7 and other bacterial contaminants in meats during further processing. Regulation of measures used to kill pathogens in foods pertains mainly to cooking and canning (12, 37).

Increasingly, CFIA inspectors oversee and verify the industry efforts to employ these controls. An important way that CFIA achieves this is through their FSEP program, which is designed to encourage industry to develop, implement and maintain HACCP-based systems in meat slaughter and processing (44). This will become mandatory for all federally inspected meat establishments in the very near future. It involves implementation of six prerequisite programs that address the facilities, transportation and
storage, equipment, personnel, sanitation and pest control, recall procedures and records. For their HACCP programs per se, beef establishments would then identify E. coli O157:H7 as a hazard to be addressed in their HACCP program, identify and implement critical control points that involve some or all of the controls mentioned above, monitor and verify these critical control points, keep accurate records, take corrective actions when appropriate, and verify that the HACCP plan is working. These programs will reflect the nature of their beef products, for examples, establishments engaged in beef slaughter would have one type of HACCP program designed to minimize E. coli O157:H7 contamination of carcasses, while establishments engaged in further processing, such as raw or fermented products that are ready-to-eat, would need to have a HACCP program that includes measures to reduce levels of E. coli O157:H7 by an amount considered safe by federal standards.

Ante-mortem and post-mortem inspection have comparatively minor roles in control of E. coli O157:H7. Traditional ante-mortem inspection is limited because infected animals show no clinical signs, therefore they cannot be detected by visual examination. In some countries, for example, the U.K., there are requirements for pre-slaughter cleanliness of cattle, and those with gross fecal contamination of hides may be refused (30). In Canada and most other countries, however, there are no such requirements, and scientific studies on the relationship between pre-slaughter cleanliness and carcass contamination show inconsistent results (45, 46). Furthermore, there is no current application of pre-slaughter testing for this pathogen because of the high expected prevalence in herds, intermittent fecal shedding patterns, difficulties in obtaining truly representative samples of individual animals and herds, limitations in test capabilities and performance, and cost (47). Post-mortem inspection focuses on the control of fecal contamination of carcass surfaces.

In the last decade there has been considerable attention given to measures designed to improve the microbiological quality of raw foods of animal origin. The U.S. has implemented requirements for monitoring generic E. coli (i.e. non-O157:H7) on beef carcasses as an indicator of microbial safety (discussed in more detail in chapter 7). Federally registered establishments that wish to export beef to the U.S. are obliged to meet these requirements.

ii. Surveillance

As with CJD, E. coli O157:H7 infection in humans is a notifiable disease, and Health Canada maintains surveillance of this pathogen in cooperation with the provinces. This involves the Canadian Enteric Outbreak Surveillance Centre, Canadian Integrated Public Health Surveillance, and PulseNet as described in more detail in chapter 5. CFIA also conduct hazard surveillance of this pathogen in certain raw meat products.

3. Provincial Responsibilities And Capabilities

There is not as clear a distinction between federal and provincial responsibilities for E. coli O157:H7 control, as was the case for BSE. There are comparable responsibilities at slaughter and processing and for surveillance, but an important difference is the much larger role of provincial (perhaps more specifically, local Health Units) programs at food service and retail levels. The role of primary cattle production will also be touched on here.

i. Cattle production
It is well recognized that cattle are an important source of *E. coli* O157:H7 for humans, and much research into methods of control at the farm level have been undertaken. *Escherichia coli* O157:H7 is widespread in the cattle population, behaves as an essentially normal part of the intestinal microflora and survives reasonably well in the environment. These factors and others preclude eradication from individual herds or populations of cattle. Testing and segregation of animals has also been shown to be impractical, and risk assessment shows that most benefit would be realized from measures that reduce the prevalence of infection and the concentration of bacteria shed by animals (47). So far, no such measures have been shown to be effective under practical field conditions, however several show promise in experimental trials. These include vaccines, feed additives (e.g. sodium chlorate, propionic acid), harmless bacteria (so-called “competitive exclusion”), and use of bacteriophages, which are viruses that attack bacteria (37). It is likely that there will soon be safe and effective interventions that can be recommended for the farm level, but until that time, all that can be recommended are general measures that reflect good management and best practices, but that may or may not be beneficial. Such measures include maintaining clean pens, water and feed for livestock, and reducing general stressors that may promote microbial infections (48). As addressed above, it has been suggested that another general measure is reducing the extent of visible fecal contamination on hides before slaughter. While studies conducted in Canada and elsewhere have not consistently shown that these measures yield a beneficial effect (45, 46), they are intuitively appealing, may be beneficial under certain conditions, and probably should be encouraged as good production practices.

ii. Slaughter and meat processing

Controls for *E. coli* O157:H7 in provincially inspected abattoirs and meat processing facilities parallel those described above under federal establishments. Such differences that exist relate mainly to the level of inspection and implementation of HACCP-like programs. As discussed in more detail in chapter 6, provincial abattoirs have long been subject to inspection, but so-called free standing meat processors often have received minimal attention, therefore this represents a significant gap in control. Secondly, FSEP addresses HACCP principles in federal establishments, and until this year (2004), there has been no comparable provincial program in Ontario. This has been another important gap that is being addressed through OMAF’s new HACCP Advantage program.

iii. Retail, foodservice, foodhandling

Epidemiological studies have clearly shown the importance of safe food handling and other interventions at retail, food service and the home for the effective control of *E. coli* O157:H7 (28, 30, 49). While this pathogen may be present on raw foods of animal origin, other potential sources must also be considered, including other foods, people, contact surfaces, and contaminated water. Furthermore, this pathogen may grow and reach dangerous concentrations in certain foods if storage temperatures are abused (37, 43). Industry, public health inspectors, and consumers must share control efforts. Evidence suggests that these are best achieved through HACCP-based food safety programs that provide for general sanitation and hygiene as well as specific interventions, food handler training, and regular inspection with verification (30, 31). Examples of interventions that may be applied at this level include: monitoring of microbiological quality of product from suppliers, temperature monitoring at key transportation and storage points, proper cooking and refrigeration, standard operating procedures for food handling, including good hygiene practices, and food handler training (37).
The responsibilities of food premises operators and public health inspectors that pertain to control of microbiological hazards in meat are described in detail in chapter 6. In brief, food premises operators are responsible for keeping records of meat product manufacturing, handling, etc., abiding by regulations of the Health Protection and Promotion Act for sanitation, storage, handling of foods and sale of inspected meat. For inspectors, the Mandatory Health Programs and Services Guidelines require Health Units to undertake risk assessments of food premises, where risks from *E. coli* O157:H7 would be directly or indirectly addressed (e.g. premises preparing hazardous foods from raw meats and serving vulnerable populations are considered “high risk”). As described in chapter 6, these assessments affect inspection frequency and requirements of inspection, which are HACCP-based. Health units are also required to ensure that food handler training courses are provided, although a gap currently exists in making these courses mandatory. Additional responsibilities and capabilities of inspectors that pertain to control of *E. coli* O157:H7 include foodborne disease outbreak investigation and food recalls, sometimes through the Ontario Inter-Agency Council on Food Safety, in conjunction with Ministry of Health and Long-Term Care (MOHLTC), OMAF and other provincial ministries, and federally with CFIA and Health Canada. Other important capabilities include well-trained inspectors and Medical Officers of Health, cooperation with hospitals and attending physicians, and trained epidemiologists and microbiologists with the MOHLTC.

Various ministries and many Health Units promote enhanced safe food handling practices for prevention of *E. coli* O157:H7 and other foodborne pathogens, especially for consumers. Efforts include various types of website information, brochures, and participation in the Canadian Partnership for Food Safety Education (50).

iv. Surveillance

Foodborne infections of all types, and specifically verotoxin producing *E. coli* infections (VTEC) of humans, such as *E. coli* O157:H7, are reportable in Ontario; therefore all medical practitioners and others in the health care system are obliged to notify these infections to the Medical Officer of Health, who in turn must report them to OMHLTC. As described in chapter 5, these are tracked in the Reportable Disease Information System (RDIS) system. Deficiencies in the RDIS system were described in chapter 6, and it is expected that the system will be replaced soon. OMAF conducts hazard surveillance on *E. coli* O157:H7 through its baseline studies of meat.

v. Overall analysis of provincial capabilities for *E. coli* O157:H7 control

Control of *E. coli* O157:H7 is difficult and requires a farm-to-fork approach. In Ontario there are important capabilities from production through consumption that include both public and private sector activities, as well as consumer responsibilities. At the farm level, there are currently few direct actions that farmers can take to reduce *E. coli* O157:H7 shedding in cattle, although some general practices may help, such as providing clean feed and water for animals and presenting clean animals at slaughter. At slaughter, processing, foodservice, retail and in the home, it is critical to limit microbiological contamination of meat, prevent growth of *E. coli* O157:H7 in meat, and where possible kill these bacteria by proper cooking. Important capabilities include meat inspection and food premises inspection. Current gaps include lack of universal HACCP-based food safety and tracking systems that pertain to *E. coli* O157:H7 and problems with disease reporting capabilities, but these are addressed in more detail in other chapters. While important elements of a comprehensive set of controls exist in Ontario, in some cases...
these appear to function more-or-less in isolation. Therefore greater coordination among those responsible is needed for effective control of this important pathogen, which causes hundreds of cases of illness in Ontario every year.

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CHAPTER 9
LOOKING AHEAD

I. A REGULATORY FRAMEWORK FOR A STRONG MEAT INSPECTION SYSTEM

1. Introduction

For a jurisdiction like the Province of Ontario, what would a model science-based meat inspection regime look like? From a scientific perspective, what should be done to strengthen the existing system to have it more closely approximate the model legislative and regulatory regime?

As to the first question, fortunately this Panel does not have to begin from scratch to develop a model regulatory inspection system; through a remarkable consensus building process over an eight-year period, a group of food safety regulators and meat inspection specialists from across Canada have succeeded in developing a model National Meat and Poultry Regulations and Code (NMPRC). This regime has been approved by all provinces and the federal government; it represents an extraordinary scientific/regulatory achievement.

As to the second question, we have reviewed this regulatory scheme, the proposed Food Safety and Quality Act, 2001 and its companion legislation, the Health Protection and Promotion Act, and we conclude that taken together this system, adequately resourced, with a few important improvements that are discussed below, would significantly strengthen the existing system and would give Ontario a strong and comprehensive meat inspection regime as good or better than any provincial system in Canada and roughly equivalent to the federal system which has been internationally recognized as equivalent to the best in the world.

2. The National Meat and Poultry Regulations and Code (NMPRC)

In 1994 Federal and Provincial Ministers of Agriculture endorsed a Blueprint for a modernized national food inspection system and charged a group of public servants, The Canadian Food Inspection System Implementation Group (CFISIG), to make the Blueprint vision a reality. Each province and federal government sent representatives from their health and agriculture departments and the group also had representation from the community of municipal public health inspectors. CFISIG’s membership of about 35 food inspection specialists meet twice yearly in plenary to oversee the development of national commodity codes by sub groups and to adopt them by consensus when they are concluded. CFISIG is not a law-making group; its role is to develop model science-based national codes that could then be adopted by the respective federal and provincial governments. The first national code to be developed and adopted was the National Dairy Code which has been subsequently legislated by most jurisdictions so that Canada now has a reasonably harmonized national system.

The second commodity to be worked on was a National Meat and Poultry Code. Working closely with industry, national consultations were carried out over a two year period and hundreds of amendments were worked through. At its plenary in October, 2002, CFISIG adopted the Model National Meat and Poultry Regulations and Code.
In November 2001, the CFIA, Health Canada and the Ontario Ministry of Agriculture and Food (as the provincial/territorial representative), agreed to undertake a comparison of the NMPRC with relevant federal regulations and proposed regulations, policies and guidelines to determine the extent to which the NMPRC could be regarded as equivalent to federal policies and standards. Over the course of two years, this group, called the Parallel Meat Review Committee, had ten meetings and carried out line by line comparisons and detailed spreadsheets were prepared to comprehensively analyze equivalency. The Parallel Meat Review Committee determined that the NMPRC is the acceptable scientific safety standard for domestic meat slaughter and processing and can be regarded as equivalent to the relevant federal regulations, policies and guidelines relating to food safety.

This Panel has reviewed the Report of the Parallel Meat Review Committee and agrees with its conclusions. Accordingly, we recommend that the Province of Ontario adopt regulations that are equivalent to the National Meat and Poultry Regulations and Code.

3. The Food Safety and Quality Act

The Province of Ontario has been an active member of CFISIG since its inception in 1994 and worked closely with other jurisdictions to develop a Model Act for Food Safety and Inspection and the National Model Regulation for Food Safety which were adopted by CFISIG in March of 2001. Building on this, Ontario passed The Food Safety and Quality Act, 2001 (FSQA) but this Act has not yet been proclaimed.

The FSQA sets out regulatory and food safety risk powers and requirements that:

- Would establish food safety and quality standards for food related activities and for food, agricultural and aquatic commodities and agricultural inputs;
- Would provide for the investigation of food safety risks related to designated products or commodities that pose a significant risk to public health or safety; and
- Require mandatory disclosure of information to specified officials, and others as necessary.

With respect to regulated activities or commodities, the Act provides:

- The ability to conduct inspections;
- The authority to execute warrantless searches in circumstances where the time required to obtain a warrant would result in the loss of evidence;
- The ability by inspectors to issue compliance orders, e.g., to abattoir operators;
- The ability to establish by regulation, a system for tracking and tracing of food or commodities;

In circumstances related to a food safety risk, the Act provides, with respect to designated products or commodities:

- The authority to execute warrantless searches in circumstances where the time required to obtain a warrant would result in the loss of evidence;

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• The ability to issue preventative orders for the purpose of preventing, decreasing, controlling or eliminating a food safety risk;

• The ability to make inquiries to obtain information related to a food safety risk and despite the provisions of the *Freedom of Information and Protection of Privacy Act*, requires the disclosure of such information to any person where it is necessary to do so to protect the health and safety of the public or any person.

The Act also requires

• The reporting to the Local Medical Officer of Health or the Chief Medical Officer of Health of any matter that is or may be a food safety risk that constitutes a significant risk to public health and safety.

The FSQA is also an essential pre-condition for the promulgation of the new Meat Inspection Regulations that we have recommended above. We have reviewed the FSQA from a scientific and regulatory perspective and **recommend that** the Food Safety and Quality Act be proclaimed without further delay.

While the proclamation of the *Food Safety and Quality Act* and detailed Meat Inspection Regulations equivalent to the National Meat and Poultry Regulations and Code will require additional resources for improved inspection capacity, they will also require the maintenance of a strong science and laboratory capacity to provide the necessary scientific foundation for the meat inspection system.

**We recommend that** Ontario maintain a high quality food safety science capacity that is based on solid research, surveillance and risk analysis.

**4. Health Protection and Promotion Act: Food Premises Regulation**

CFISIG also developed over several years a national model Food Retail and Food Services Regulation. The Ministry of Health and Long-Term Care has carried out extensive consultations with stakeholders to ensure that Ontario has equivalency with the National Model Regulations. In this regard, one of the necessary changes is to make it mandatory for certain employees in foodservice and food retail premises that are classified as “high” or “medium” risk to be trained and certified in safe food handling.

The Ministry is in the process of seeking approval to amend the Food Premises Regulation. The proposed amendments include mandatory food handler training/certification and certain technical amendments that would see cooking temperatures for certain meat products and the exclusion of uninspected meat from food premises, prescribed in the regulation.

It has been proposed that the mandatory food handler training/certification program would be phased in over a 5 year period for high-risk establishments and within 7 years for medium-risk establishments. “High-risk” food premises are those which prepare hazardous foods and serve to a high-risk population (e.g., nursing homes and hospitals), use processes involving many preparation steps and foods frequently implicated as the cause of food-borne illness (e.g., full menu restaurants), and/or have been implicated as a source of food-borne illness/outbreak. “Medium-risk” food premises are those which prepare hazardous foods without meeting the criteria for high-risk (i.e., fast food restaurants) and/or prepare non-hazardous foods with extensive handling or high volume (e.g., bakeries). “Low-risk”
premises are those which do not prepare hazardous foods but may serve prepackaged hazardous foods, e.g., convenience stores.

These changes represent an important complement to the FSQA and Meat Inspection Regulations. Accordingly, **we recommend that** the proposed amendments to the Food Premises Regulation be adopted but with a phase in time for mandatory food handler training/certification of no longer than two years for high risk and medium risk establishments.

II. **ADDITIONAL IMPROVEMENTS**

1. **Interagency Coordination**

   The complexity and globalization of the food supply has prompted many countries to streamline and integrate roles and responsibilities in food safety and food security. The formation of the Canadian Food Inspection Agency is a case in point. Similar integrations have not progressed as rapidly at Provincial levels where there still exists the traditional approach of food inspection being carried out by both the Ministries of Agriculture and Health. This split often leads to problems with coordination and effective response and communication. And, of course, because Canada is a federal system with public health and meat inspection as shared responsibility, there will always have to be continuing efforts devoted to coordinating federal and provincial activity. The following are some specific examples where improvements may be made.

   i. **Emergency preparedness**

      (a) **Issue**

      The need for the current food system in Ontario to be able to rapidly identify the presence of a threat introduced accidentally or purposefully.

      (b) **Background**

      Following the events of September 11, 2001 there was a fundamental change in how Canadians perceived the importance of emergency preparedness in the public health system. These perceptions became further entrenched when the SARS outbreak demonstrated how vulnerable large cities and their infrastructure were to the introduction of an unexpected pathogen. New attention was also focused on food and water supplies, since these systems could be used as vehicles to rapidly disseminate a threat to large numbers of humans and animals and their environment. In Canada, new initiatives to strengthen preparedness against terrorist attacks included the creation of the CBRN (Chemical, Biological, Radiological, and Nuclear) Research and Technology Initiative (CRTI) ([www.crti.drde-rrdc.gc.ca](http://www.crti.drde-rrdc.gc.ca)) which has stimulated a rapid expansion of science capacity to deal with CBRN threats. Recently, the Federal government announced the creation of the new portfolio of Public Safety and Emergency Preparedness. It includes emergency preparedness, crisis management, national security, corrections, policing, oversight, crime prevention and border functions. Provincial and municipal governments have also created enhanced infrastructure such as the creation of the first Commissioner of Public Safety and the Commissioner of Public Health. These measures have enhanced public confidence by increasing the profile of these officials making them more visible and credible to the general public. In a similar manner, risk communication of animal health and meat inspection issues would be improved if there was a Chief
Veterinary Officer for Ontario who could speak to the public on all matters arising from the animal industry and wildlife sectors. The adoption of the *Ontario Emergency Management Act* has established emergency preparedness standards to be implemented by all municipalities within well-defined timelines.

An important component of Emergency Preparedness is surveillance. Unfortunately, linkages between food safety surveillance systems of the private, municipal, provincial and federal levels remain antiquated, under funded and unable to cross communicate in a real time fashion. During the same period, the United States of America has increased investment 15 fold since 2001 in Bioterrorism preparedness. Over 665 new positions were added to the FDA food safety field activities, the number of food import inspections was quadrupled, and threat assessments to the food system were undertaken using the Operational Risk Management analytical framework. Most importantly, surveillance systems were dramatically enhanced by the creation of the Food Emergency Response Network (FERN) and the expansion of the eLEXNET system to include over 97 laboratories in 48 states. This system can track over 3,700 food safety analytes in a rapid, secure and coordinated manner that gives the United States a functional early warning system for threats to the food supply.

(c) Recommendations

**We recommend that the Province of Ontario:**

ii. Establish an **Ontario Food Safety Reporting Centre (OFSRC)**. This Centre would be responsible for coordination for all matters relating to food safety reporting in the Province. The OFSRC would report to the Chief Medical Officer of Health for the Province of Ontario. All Ministries in the Province that have responsibilities in food safety (OMAF, MOHLTC and MNR) would be required to report any data, issues and concerns to the OFSRC. The OFSRC would be equipped with the technology and resources to provide real-time reporting from multiple jurisdictions and analytical and GIS mapping capability. This Centre would provide early warning and coordination to ensure rapid investigation of threats and unusual occurrences in Ontario, risk communication with the public and provide linkages to Federal authorities.

iii. Create the new position of **Chief Veterinary Officer for Ontario** that would have responsibility for meat inspection and animal health within the province.

iv. Implement electronic submission and reporting forms for the food safety investigation samples submitted by Public Health Inspectors that would be comparable to the electronic system currently in place for the Meat Inspection Program of the Food Inspection Branch, OMAF.

v. Implement the eLEXNET system (or a comparable system) in all food laboratories (Federal, Provincial, and Private) in Ontario. This type of system can extract and integrate data from differing reporting systems.

vi. Carry out a review to determine whether the capacity of the current level 3 containment facilities is adequate to support investigations into emerging pathogens and other sources of foodborne illness and to fund the necessary enhancement.
vii. Expand its capacity to conduct testing and research on the causes of foodborne illnesses and on prion related zoonotic diseases such as bovine spongiform encephalopathy (BSE).

viii. Emergency response: food recalls

(a) Issue

The need for improved collaboration and communication among the multiple agencies involved in food recalls.

(b) Background

Food recalls involving meat or meat products can be initiated by any one of the following: Canadian Food Inspection Agency, Ontario Ministry of Health and Long-Term Care and local Medical Officer of Health. Regardless of who initiates the recall, such action usually has implications for the other parties. In recognition of this, the role and responsibilities for each agency have been well defined both in legislation and protocols.

In an effort to maximize collaboration and efficiency in the investigation of foodborne illness outbreaks and product recalls, a Memorandum of Understanding for Foodborne Illness Outbreak and Hazard Response and Product Recalls has been established. This Memorandum of Understanding involves the Canadian Food Inspection Agency, Health Canada, the Ontario Ministry of Agriculture and Food, the Ontario Ministry of Health and Long-Term Care, the Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources.

Another important vehicle to facilitate communication and resolve issues related to coordinating food safety programming in Ontario, is the Ontario Inter Agency Council on Food Safety on which all of the signatories to the Memorandum of Understanding have representation. The purpose of the council is to:

(1) Provide for timely interagency communication on issues relating to mandate

(2) Provide the forum to resolve issues to coordinating food safety programming in Ontario. This will be accomplished by coordinating activities in the following areas:

- Product Inspection
- Establishment Inspection
- Enforcement
- Emergency Response
- Education / Training
- Standards / Legislation
- Laboratories / Research

(3) Provide a forum for the development of interagency MOUs
Clearly, many of the structures are in place for efficient agency interaction on both an ongoing and crisis basis. Yet there continue to be difficulties from an implementation perspective as evidenced by the recent incidents. Invariably, these centre on matters related to inadequacies in the surveillance system, lack of clear overall authority and timely, open communication among the players involved.

(c) Recommendation

We recommend that the Chief Medical Officer of Health through the Ontario Food Safety Reporting Centre ensure the activation of the Ontario Outbreak Investigation Coordinating Committee (OOICC) for all appropriate food safety situations as designated under the Memorandum of Understanding for Foodborne Illness Outbreak and Hazard Response and Product Recalls, including appropriate food recall situations.

ix. Surveillance

(a) Issue

The current national and provincial communicable disease surveillance system is inadequate for effective data collection, data analysis and dissemination of information to those who plan and carry out food safety programs.

(b) Background

The current Ontario communicable disease surveillance system, the Reportable Disease Information System (RDIS), is a stand-alone system which is outdated and requires immediate replacement. The limitations of RDIS were well highlighted in the recently released report of the National Advisory Committee on SARS and Public Health and the Interim Report (December 2003) of the Ontario Expert Panel on SARS and Infectious Disease Control. Steps are underway to achieve this end with government commitment having been made for the phased implementation of the National Integrated Public Health Information System (iPHIS). In addition to the need for establishment of an integrated, flexible information technology surveillance system, the Expert Panel on SARS and Infectious Disease Control highlighted the need for improved cooperation and communication among community agencies including hospitals, public health units, physicians, laboratories, walk-in clinics, community care access centres, etc., from a disease monitoring and control perspective.

Both the National Advisory Committee Report1 and the Interim Report of the Ontario Expert Panel2 have done outstanding work and endorse the establishment of a regional infection control model supported centrally by a new Canadian Public Health Agency. This model would link public health units, hospital and infection practitioners, emergency health services and long-term care and community based health care providers for the purposes of enhanced infectious disease surveillance and outbreak response. While driven by the need for improving the provincial and national response to a future communicable disease crisis such as SARS, a Regional Infection Control Model would also enhance foodborne disease surveillance and response. The federal government recently announced significant funding for the

establishment of the Canada Public Health Agency and so the opportunity for real change has never been greater.

(c) Recommendation

We recommend that the relevant recommendations of the Interim Report of the Ontario Expert Panel on SARS and Infectious Disease Control, including Recommendations 10, 36, 37, 38, 39, 40, 41 be implemented.

For ease of reference, those recommendations are as follows:

1. **Recommendation 10**

   "The Ministry should establish a process to develop regional infection control networks across Ontario with a designated hospital and public health unit as joint leads in the development process. The networks should include but not be limited to public health units, hospital infection control practitioners, emergency health services, long-term care, and community based health care providers."

2. **Recommendation 36**

   "The Ministry should build on work undertaken to date and develop a comprehensive, provincial infectious disease surveillance plan by June 30, 2004. This work should:
   
   - be carried out by a multi-disciplinary group, which includes scientific, government, information technology and health care partners, and which is accountable to the Minister of Health and Long-Term Care.
   - involve aligning and clarifying the roles of post-SARS provincial advisory committees with working groups examining the issue of disease surveillance.
   - examine any opportunities or barriers to using existing tools such as Telehealth and Telemedicine.
   - include province-wide surveillance for facility-acquired infections."

3. **Recommendation 37**

   "The Ministry must ensure that an appropriate information technology infrastructure is in place to fully support the provincial infectious disease surveillance plan by June 30, 2004."

4. **Recommendation 38**

   "The Ministry should expedite the full implementation of the Integrated Public Health Information System (iPHIS), together with any required design modifications, across all Public Health Units in the province by June 30, 2004."

5. **Recommendation 39**

   "The Ministry must move rapidly to fully implement the necessary information technology supports to allow for contact tracing and quarantine management by Public Health Units by June 30, 2004. If this cannot be accomplished through design modifications to iPHIS, other suitable information technology platforms must be used."

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Recommendation 40

“The Ministry should establish a working group with representation from healthcare stakeholders, researchers, and the Ministry to review on an urgent basis all data access and data sharing protocols between Public Health Units, the Ministry, municipalities, and the federal government. This review should identify how and to whom identifiable personal information is authorized to flow in the event of an outbreak. The working group should submit a report to the Minister by March 31, 2004 outlining the common data sharing structure, reporting relationships, and other common requirements of the data access and sharing protocols.”

Recommendation 41

“The Ministry should undertake a detailed legislative review of the Freedom of Information and Protection of Privacy Act and the Municipal Freedom of Information and Protection of Privacy Act in the context of:

- the reporting requirements set out under the Health Protection and Promotion Act.
- identifying potential barriers to the sharing of information in appropriate and timely manner.
- ensuring appropriate protections for personal information.”

2. Dead Stock

The May 2003 discovery of BSE in western Canada and its after-affects, including closure of the U.S. border to trade in many animal-derived products, and an anticipated voluntary ban on use of animal-derived protein in pig feeds, have precipitated a crisis in dead stock and rendering industries. Before the BSE-related problems, for the year 2002, renderers reported 34,000 tonnes of dead stock was rendered in Ontario. For the preceding 12 months (as of March 2004) the same renderers estimate a volume of 26,680 tonnes.

With the ongoing restrictions at the USA/Canadian border, one can expect more backup of live animals on Canadian farms. This accumulation of animals, especially given the increased ages of the provincial herd, will result in greater dead stock numbers.

Since the rendering industry is receiving fewer volumes and the pet food use of boned dead stock is flat, the question as to how these increased volumes of dead stock are being disposed, or will be disposed in the future, is unclear. Some have been diverted to burial and composting on farms and some to less controllable incineration and carnivorous ingestion by wildlife.

There are significant food safety, animal health and environmental concerns at stake. Efficient and affordable animal disposal is essential to on-farm hygiene and infectious disease control. Traditional “recycling” measures such as use of meat and bone meal in animal rations are less feasible. It is not acceptable on environmental grounds to simply re-direct these materials to land fills. As long as we are going to raise livestock for food, society has a responsibility to dispose of their remains in a safe manner.

To address these concerns, regulations under Ontario’s Dead Animal Disposal Act of 1963 require updating as described in the following sections.

i. Dead stock handling capacity
(a) Issue

There is a need for increased capacity to handle dead stock in a safe and efficient manner.

(b) Background

Other than rendering there is currently no provision under the DADA for licensure of central facilities for dead stock disposal. Increasing the options for on-farm disposal to include incineration would assist producers in some areas and legalize an activity for others. Expanding this option to include centralized provisions of incineration, composting, transfer stations and newly evolving technologies could help to assist with the dead stock dilemma. In addition, if the operations are properly conducted, these facilities could reduce or inactivate disease risks.

Disposal of some "minor" species (e.g. poultry, mink, ratites and domestic deer) is not addressed under the current legislation. These should be included along with the major livestock species so as to provide assurance that their remnants are effectively controlled.

Sheep and goats as well as the inedible portions of processed wild game are refused entry to the rendering system due to the risk of TSEs. If there is an inability to adequately dispose of these animals or their parts, this could possibly increase the spread of domestic animal diseases or could even result in foreign animal disease. e.g. BSE.

(c) Recommendation

We recommend that the necessary regulatory changes be made to increase the capacity to handle dead stock efficiently and safely. These changes include licensure of on-farm incinerators, composting, central compost and incineration facilities, transfer stations and inclusion of “minor use” species.

The province should work with other provinces in a search for improvements to dead stock disposal by pooling their individual successes and resources. Provinces should collectively be encouraging the federal government to work and assist them; the federal government too has a responsibility to avoid foreign animal disease incursions and minimize risks to the national herd.

ii. Incentives for collection

(a) Issue

The economic outlook for the dead stock industry is grim and necessary carcass disposal services are endangered.

(b) Background

Reduced demand for hides, pet food, and rendered products has dramatically reduced profitability in the industry and is forcing many dead stock collectors/receivers to consider leaving the business. The “Healthy Futures” program provided dead stock collectors with some financial support, but the program is due to end in March 2004 and there is a possibility of carcass accumulation problems.

A strategy is required to reverse the 'disposal' of dead stock approach and replace it with an 'alternative recycling' focus. Yellow grease from dead stock would be available at relatively low cost to generate biodiesel energy. Each tonne of dead stock, when rendered, can produce fertilizer with a value of
$72. Some E.U. countries have co-incineration facilities for dead stock and abattoir wastes that produce biogas (for energy) and a product used in cement.

(c) Recommendation

We recommend that the province provide interim financial support to the dead stock industry (collectors, facilities operators) to see it through the present crisis and ensure collections and safe disposal continue in the short term. The industry and the ministry should co-ordinate their planning and resourcing for longer term solutions involving alternative recycling.

iii. Transportation and biosecurity

(a) Issue

Dead stock disposed off-farm must be moved in a manner that protects public health, animal health and discourages fraudulent activity.

(b) Background

Transport of dead stock is expensive and currently must be performed by licensed collectors/receivers. As economic returns in the industry diminish, operators are less inclined to travel to farms, especially for smaller animals. The current regulations stipulate that animal owners must dispose of their dead animals within 48 hours of death, so they cannot “batch” animals for pickup. Some producers have been transporting dead stock from their farm for disposal elsewhere. Protocols on the transportation of dead stock need to be enhanced and supported by regulation and enforcement. This would help sustain two major considerations: 1.) reduce the spread of livestock disease due to transportation; 2.) reduce any chance of those materials being circumvented to the human food chain. It must be acknowledged that by transporting dead stock off-premises there is an increased risk of the spread of livestock diseases.

(c) Recommendations

We recommend that producers be allowed to transport their own dead stock to central disposal facilities using appropriate safeguards, and that dead stock can be held longer than 48 hours on farm with proper refrigeration and storage.

iv. Capabilities for trace-back and surveillance

(a) Issue

Dead stock is part of the food chain and need to be part of the trace-back and surveillance systems for food safety and animal health.

(b) Background

Dead and disabled or fallen stock are high risk populations for a variety of diseases of importance to food safety and animal health, and are more likely to have been treated with antimicrobials or other drugs. This means that they are more likely to harbour pathogens or be contaminated with residues and therefore need to be available for surveillance testing. Furthermore, there are occasions when it is necessary to trace the sources of contamination, or the destination of contaminated product. In the recent
BSE cases in Canada and the U.S., traceback of rendered products was necessary, as it was a couple of years ago after carbadox contamination of rendered products from swine.

Although difficult to quantify, there are instances of illegal slaughtering of livestock. The absence of the identification of such animals could compromise any traceability efforts. In addition, slaughtering of animals in unsanitary and unregulated surroundings increases health risk and raises animal welfare concerns. If hide collectors in the province were required to report the sources and volumes of their hides, greater surveillance and control could be exercised.

(c) Recommendation

**We recommend that** dead stock be part of the food safety surveillance system in the province, and that operators keep records that enable traceback.

v. Environmental concerns

(a) Issue

Improper methods for the disposal of dead stock can have detrimental environmental impact.

(b) Background

The loss of most of the pet food market, anticipated moves by some industries to restrict or ban use of animal-derived protein in feeds, and border closure has increased demand for dead animal disposal. Since the traditional “recycling” options are reduced, other outlets will have to be used. These include composting, burial, incineration, inedible processing for industrial purposes (e.g. biodiesel production), or dumping in landfills.

(c) Recommendation

**We recommend that** the province undertake an in-depth study with significant accompanying resources to determine what environmentally sound disposal facilities are needed in Ontario. This would be followed by action to support the development and availability of the recommended processes.

3. Free Standing Meat Processing Plants

(a) Issue

Whether or not the Ontario Ministry of Agriculture and Food should have sole responsibility for inspecting free standing meat processing plants.

(b) Background

A Free Standing Meat Processing Plant has been defined as a manufacturing facility located in Ontario that:

- **conducts any of the following processes:** cutting, boning, breaking, comminution (e.g., grinding, flaking, etc.), fabrication, cooking and repackaging of meat products, and distributes some portion of its products through any wholesale or retail outlet not physically connected to the processing plant, or

- **conducts any of the following processes:** by-product dressing for human consumption (e.g. offal processing or singeing of beef feet/skin), curing, smoking, fermenting or canning of meat products or vacuum packaging of high risk meat products, and
iii. is not a federally registered establishment or a provincially licenced abattoir.

A recently conducted Ontario Ministry of Agriculture and Food (OMAF) survey identified approximately 680 such establishments in the Province. Currently, free standing meat processing plants are inspected by Public Health Inspectors employed by Public Health Units. It is understood that OMAF has proposed a regulatory change which would transfer inspection responsibility to that Ministry’s Meat Inspectors.

Public Health Inspectors do not receive meat inspection training as part of their four-year university program. They do receive training on meat processing such as curing, smoking, fermenting or canning of meat products. OMAF Inspectors do receive meat inspection training. The training emphasizes ante-mortem and post-mortem inspection, in-plant sanitation and related matters. OMAF inspectors receive training in further processing inspection on an as-needed basis. Managers determine which of their inspectors is/are best suited to further processing inspection.

Free standing meat processing plants vary greatly in size and scope of operation. Some process meat including boning, cooking and/or repackaging for direct sale to the public and/or for distribution through wholesale or retail outlets not connected to the plant. Others are small operations confined to preparation of meat products such as sausage or processed meats for direct sale to the public with no distribution to any wholesale or other retail outlet not connected to the establishment. However, it is the type of processing conducted which determines the level of risk. For example, facilities undertaking any of the processes specified in section (ii) of the definition above would be classified high risk, regardless of the size of the plant or volume of product produced.

Another challenge posed by the free standing meat processing plant definition is that many establishments which meet the definition also provide other retail food products and/or services. An example would be a retail store which specializes in food products of a particular culture or country, including the preparation of meat products related to that culture or country. These establishments fall within the definition of food premises under the Ontario Health Protection and Promotion Act’s Food Premises Regulation.

As a result, no matter who does the inspection of the meat processing component of the operation, public health inspectors will still be required to inspect the remaining food retail aspects of such establishments. Were OMAF Meat Inspectors to assume responsibility for inspecting all free standing meat processing plants, this would create the situation where two separate inspections would occur on the same food premise by staff of two different Ministries. This would be both an inefficient use of staff resources and a cumbersome system of regulation for owner/operators of the many establishments so affected.

The question of which ministry should be responsible for the free standing plants is a complex one. The provincial government is supporting the adoption of the National Meat and Poultry Regulations and Code (NMPRC). We understand the proposed Food Safety and Quality Act and accompanying regulation are consistent with the NMPRC. This, if enacted to cover both provincial abattoirs and free standing plants, would provide a level playing field of regulatory application. Presumably it could also provide enhanced market access for the free standing industry. Should this occur, provision would have
to be made for cooperative agreements (MOUs) between OMAF and the MOHLTC. This would allow
the interests of both ministries to be served.

The situation is further compounded by the current status of human resources assigned to the
inspection of free standing meat processing plants. Public Health Units do not have sufficient numbers of
public health inspectors to meet the provincial inspection frequency standards for free standing meat
processing plants. If OMAF were to assume the responsibility for inspections, a significant increase in
staff resources would be required, which in turn would necessitate enhancing OMAF training programs in
the area of meat processing. Finally, there is presently no licensure requirement for free standing meat
processing plants. This has direct implications for their identification and inspection by those
responsible, as well as for enforcement of relevant legislation.

There is a need for strengthening the current system for inspection of free standing meat
processing plants. Revisions should ensure the following: licensure of all free standing meat processing
plants; inspection of such facilities using a risk-based, scientifically determined set of standards, applied
in a consistent manner by one agency/Ministry group of inspectors; and accountability for inspection to
rest with one Ministry.

(c) Recommendations:

1. We recommend that the establishment of a provincial licensing system be established for free
standing meat processing plants.

2. We recommend that consistent with the provisions of the Ontario Food Safety and Quality Act and
its regulations, the Ministry of Agriculture and Food assume responsibility for the inspection of free
standing meat processing plants.

3. We recommend that where there is overlap in legislated responsibility between the Ontario Ministry
of Agriculture and Food and the Ministry of Health and Long-Term Care for the inspection of free
standing meat processing plants, a partnership agreement be established to avoid duplication.

4. We recommend that adequate staffing and training resources be allocated to ensure inspection
standards for free standing meat processing plants are met.

4. Training and Education

i. Mandatory food handler training: all premises

   (a) Issue

       Whether or not there should be mandatory food handler training for employees of all food
premises.

   (b) Background

       The best meat inspection and regulatory system can be undone by the last step in the food
preparation process, food handling. Proper technique in food preparation, serving and storage is essential
to preventing foodborne disease. This is as true in the home as in food premises.

       Mandatory food handler training has been advocated for years by the Canadian Institute of Public
Health Inspectors, the Ontario Public Health Association, the Association of Local Public Health


Agencies, and the Association of Supervisors of Public Health Inspectors of Ontario. The Food Retail and Food Services Regulation prepared by the Canadian Food Inspection System Implementation Group as a national code for food retail and food services premises, calls for mandatory food handler training and the presence during hours of operation of a minimum of one employee who holds a certificate from a recognized food handler training program. The food handler training protocol of the Food Safety Program of the Mandatory Health Programs and Services Guidelines under the Health Protection and Promotion Act similarly requires the presence of at least one employee who holds a certificate from a recognized food handler training program in each high and medium risk food premise. The protocol defines the minimum content of a food handler training program.

Despite all of the above, Ontario does not currently require mandatory food handler training for the food service industry.

(c) Recommendations

1. **We recommend that** mandatory food handler training be implemented for all medium and high risk food premises consistent with the requirements of the Food Handler Training Protocol of the Food Safety Program of the Mandatory Health Programs and Services Guidelines of the Health Protection and Promotion Act and this includes the medium and high risk facilities within the provincially licenced abattoirs.

2. **We recommend that** mandatory food handler training be phased in over a two-year period, with recertification every five years.

   ii. HACCP Training

   (a) Issue

   An expanded role for HACCP will require training of inspectors and industry personnel.

   (b) Background

   Training is an important component of a HACCP-based food safety program. Not only do the “inspectors/verifiers” have to be trained in food safety, but establishment operators also have to be trained. This will facilitate everyone getting the same training at the same time and foster on-going dialogue between the two groups. Furthermore, it will encourage common problem-solving and continuous improvement in food safety programs. An alternate approach would be to establish a system whereby trained food safety extension specialists would assist the industry in implementation and maintenance of food safety programs. These personnel would be separate from the inspection staff. Funding could be on a cost-sharing basis with the government providing the trained personnel and the industry pay on an as-needed basis. The former system is preferred and probably would be more cost effective.

   (c) Recommendation

   **We recommend that** the province develop a HACCP-based food safety system and provide HACCP training to all its inspectors and establishment operators following the same program where appropriate.

   iii. Food handling in the home
(a) Issue

There is a need for improved food handling in the home.

(b) Background

Food can be mishandled in the home setting increasing the risk of foodborne illness. A number of studies have shown the importance of improper food handling in the epidemiology of foodborne illness. Important risk factors include improper handling of raw meat and poultry, failure to maintain proper refrigeration temperatures, cross contamination of cooked products from uncooked products, failure to clean cutting boards, knives, work surfaces and hands after handling potentially contaminate foods, and other factors.

Despite the efforts of food safety programs, foodborne illness is still a prevalent cause for disease at a national and international level. Multilevel community intervention programs can affect long-term knowledge and behaviours, however positive findings have not yet been seen.

(c) Recommendation

We recommend that existing food safety informational strategies be evaluated for effectiveness and that new informational campaigns be researched and developed to more effectively compel consumers to practice safe food handling and exercise safe food choices in the home.

5. On-Farm Issues and Traceability

All sectors of the food industry have a responsibility and interest in ensuring safe food. Maintaining control over the entire farm-to-fork food production process is vital to food safety. An ideal food safety system has an infrastructure to trace the origins and destinations of whole and processed food and their inputs.

It is also important to encourage the flow of relevant and useful food safety information throughout the food chain, especially where this facilitates informed decisions by meat and public health inspectors. At the same time, it is important to respect appropriate concerns about confidentiality.

Non-ambulatory livestock (downers) is another issue that needs to be addressed further. As mentioned, Ontario has a good program in place that requires veterinary examination and certification of downers prior to transport and slaughter. However, the great majority of these animals are cattle, and the recent cases of BSE have brought about significant changes in management of downer cattle in Canada. There are also other concerns about downers, including humane treatment and food safety.

i. Traceability

(a) Issue

There is a need for enhanced traceability of meat throughout the farm-to-fork continuum.

(b) Background

Open and transparent traceability of a food product can strengthen the management of food safety along the farm-to-fork continuum. Many epidemiological investigations of Canadian foodborne outbreaks are completed without discovering what went wrong. A transparent traceability system can link the components of the food production chain, and bring greater accountability along the continuum.
(c) Recommendation

We recommend that all sectors in the meat industry develop effective food safety traceability systems.

ii. Flow of food safety data through the food chain, but especially from farm to slaughter.

(a) Issue

To enhance effective meat inspection, there is a need for provision of relevant and timely on-farm food safety information.

(b) Background

Ontario’s program of pre-slaughter certification of non-ambulatory livestock is a good example of providing important information from the farm and attending veterinarian to the inspector in the slaughterhouse. Another example is the recently introduced “flock sheet” program in the poultry industry, where antimicrobial treatment, flock health and other relevant data accompany birds to slaughter. There is a need for broader application of this principle.

(c) Recommendation

We recommend that all commodity groups develop programs for the transfer of relevant animal health and on-farm food safety information that would accompany animals sent from farm to slaughter.

iii. Non-ambulatory (downer) livestock

Non-ambulatory animals, in particular cattle, have been a food safety and animal welfare concern for a number of years. Recent events, however, have compounded the importance of the downer issue in Ontario. BSE was discovered in downer cows in Alberta and in Washington State, U.S.A. in 2003. The U.S. Department of Agriculture recently banned slaughter of downers in U.S. slaughterhouses, and the CFIA has recently advised federally inspected Canadian establishments that if they wish to have access to U.S. markets, they will also have to stop processing downers. This is likely to greatly increase the pressure on provincially inspected abattoirs to handle these animals.

In addition, some stakeholders are very concerned about the humane aspects of downer animal transport and handling, and a natural reaction of many consumers is a perception that meat from these animals is unwholesome. However, many downer animals have injuries or other problems that on close examination have little or no relationship to food safety or wholesomeness, and therefore it would be wasteful not to use the meat from these animals provided it meets inspection standards. Furthermore, banning these animals from the food chain could encourage illegal sale of uninspected meat processed under unhygienic conditions.

Solutions to the downer cow problem should address this complex array of food safety, animal welfare, economic and consumer confidence issues. In an attempt to simplify things, we address these issues separately.

(a) Issue

Food safety and consumer confidence concerns about downers, especially cattle.
(b) Background

Non-ambulatory animals, especially cattle, are known to be at increased risk of certain food safety hazards. These include diseased tissue, antimicrobial residues, and BSE, although the absolute risk of BSE in Ontario cattle is currently thought to be very small. Diseased tissue is effectively identified and removed through proper routine ante-mortem and post-mortem inspection. Residues of antimicrobials or other veterinary medicines are more of a concern in downers than most other groups of cattle because downers are more likely to have been recently treated, perhaps without observance of the necessary pre-slaughter treatment withdrawal times. Ontario has made a significant contribution to addressing this problem through its requirement for veterinary certification prior to transport and slaughter. Veterinarians are asked to describe recent health and treatment information on the certificate. If proper withdrawal times have not been observed, then the inspector can judge the animals as unfit for human consumption. In addition, tissues from downers are routinely tested for antimicrobial residues, while the carcasses are held pending test results from the laboratory. This level of testing is warranted because illegal residues, when they occur, may be present in all edible tissues, including meat, and cannot be seen by inspectors or trimmed out. These measures adequately address food safety concerns from diseased tissue and antimicrobial drugs or other medicines in downers.

With discovery of indigenous BSE in North America, we now have to confront the food safety and consumer confidence issues posed by the risk of BSE in downer cattle. We believe that there is now a very small, but nevertheless greater than zero, risk of BSE in Canadian cattle. While all cattle are theoretically at some risk, evidence shows that the risk is greater in older animals, especially those born before the MBM feeding ban of 1997, and in the so-called 4 D groups; dead, dying, disabled and diseased. For example, in the U.K., which has had over 95% of BSE cases in the world, approximately 0.20% of fallen (dead) stock over 24 months of age, 0.37% of casualties (animals subject to emergency slaughter, including downers), and 0.006% of apparently healthy cattle were positive for BSE on laboratory testing from among the greater than 850,000 animals tested in all categories during the period 2001 to 2003.

Short of banning downers from the human food chain, several measures are available to address BSE food safety and consumer confidence issues. As discussed in chapter 8, available scientific information indicates that the most critical and widely applicable food safety measures for BSE are effective ante-mortem and post-mortem inspection (based on objective criteria designed to keep BSE-affected cattle out of the food chain) and effective SRM removal from carcasses. Effective SRM removal includes removal of the skull, brain, trigeminal ganglia, eyes, tonsils, spinal cord and dorsal root ganglia of cattle over 30 months of age (OTM), and the distal ileum of cattle of all ages, and may also include exclusion of certain raw materials from mechanical meat recovery methods and exclusion of stunning methods using pressurized air. British authorities report that removal of SRM removes greater than 99% of infectivity in an infected animal. Ante-mortem inspection will remove from the human food chain

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those animals showing clinical signs of neurological disease. Laboratory testing is another control option, and some countries (e.g. U.K. and Japan) use such testing for inspection purposes. While at this time there is no testing for inspection purposes in North America, there are currently some U.S. operators seeking permission from the authorities to conduct private testing of carcasses in order to satisfy the import requirements of another country. As the above U.K. data show, testing identifies at least some clinically normal BSE-positive animals that would not be identified on ante-mortem inspection. Laboratory testing is not perfect, however, because it is believed that only animals in the late stages of disease are likely to be positive\(^5\). This application of testing must be distinguished from surveillance testing that is intended to determine if BSE exists in a population of cattle, and at what level. Such surveillance testing is not serving a direct food safety purpose, but is nevertheless critical for determining the overall BSE status of the provincial herd.

Will implementation of some or all of these measures provide 100% assurance of safety? The short answer is no, because BSE risk cannot be absolutely eliminated unless all beef is banned. We do not know all the facts about BSE and risks to humans, and the science in this field is continuing to evolve. In addition to the small but real limitations in the ante-mortem inspection, SRM removal and testing controls described above, there is also a very small chance that some SRM could contaminate some meat even with high-quality inspection, and HACCP-like food safety programs in place. Nevertheless, we believe that the available scientific evidence suggests that sound, strictly enforced inspection and SRM removal programs provide a very high degree of public health protection, and that these measures are proportionate to the very small BSE risk posed by all groups of cattle in Canada, including downers. We recognise, however, that additional measures may be needed to fully address consumer confidence issues, especially in the case of downers.

Several options are available for managing these consumer confidence and risk communication issues (see discussion of animal welfare issues below). The optimal choice will depend on a number of factors, including costs to farmers, the desirable and undesirable implications of actions taken, effects on businesses, and likely benefit to consumer confidence. The following are possible options for actions that could be taken in addition to sound, strictly enforced inspection and SRM removal programs based on objective criteria that are directed at removal of BSE-suspect animals and potentially contaminated tissues from the food chain. These options could be implemented individually or in combination, and are followed by a list of possible implications to be considered.

Options for managing BSE consumer confidence issues concerning downers:

1. Implement no further actions beyond the mandatory sound, strictly enforced inspection and SRM removal programs
2. Improve enforcement and rigour of existing measures (including veterinary certificates, on-farm and abattoir HACCP-like food safety programs)

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3. Include BSE laboratory testing of some downers as part of the inspection process (i.e. negative test required to pass inspection):
   a. All except young cattle with limb fractures or other obvious acute injuries
   b. All animals > 30 months (as used in Europe for clinically normal animals)
   c. All animals > 24 months (as used in Europe for emergency slaughter animals)
   d. At discretion of inspector and veterinarian
4. Compulsory testing of all downers for BSE
5. Ban downers, except those down due to obvious injuries (e.g. fracture) unrelated to disease
6. Ban all downers > 24 or 30 months of age
7. Ban all downers
8. Ban downers with compensation
   a. Government funding
   b. Industry funding (e.g. dairy and/or beef industry contributions, depending on dairy or beef type animal)
   c. Compensation linked to provision of surveillance samples

Possible Implications:
1. If no further actions taken:
   a. May lose some consumer confidence
   b. Highlights difference between federal and provincial systems
   c. Accepts incrementally greater risk (although still very small in absolute terms)
2. With increased enforcement
   a. Improvement on above implications
3. With testing:
   a. Small chance of detecting BSE positive animal not detected on ante-mortem inspection
   b. Increased costs of testing (could be assumed by farmer, industry or government)
   c. Problems and costs associated with holding carcasses, blood, etc. in abattoirs pending test results
   d. Need for increased laboratory capacity
   e. May divert limited food safety resources from areas of greater public health importance
   f. Increases samples for surveillance
   g. May enhance consumer confidence in meat from tested animals
   h. May detract from public confidence in meat from untested animals
4. To partial or complete ban:
   a. Reduces access to regulated slaughter and legal markets
   b. Economic impact to producers for lost value of meat
   c. Reduces magnitude of animal welfare problem associated with transport
   d. Endangers access to surveillance samples
   e. Increases on-farm animal welfare problems as farmers keep downers alive longer in an attempt to get them on their feet for later salvage
   f. Ultimate consumer protection against failures of control and scientific uncertainty
5. To ban with compensation:
   a. Costs
b. May encourage broader industry response to the problem, if industry must collectively bear costs

c. Greater access to surveillance samples

(c) Recommendation

We recommend that regulations concerning ante-mortem and post-mortem inspection, and SRM removal be strictly enforced, monitored, and be fully incorporated within HACCP-like food safety programs. Additional measures should be considered in the interests of public and business confidence concerning BSE risks from downers, with recognition of the implications of these additional measures.

iv. Non-ambulatory (downer) livestock – animal welfare

(a) Issue

Humane concerns about downers, especially cattle.

(b) Background

Transport of downer animals is particularly problematic and there are significant doubts whether it is possible to move these animals in an acceptable and humane fashion. If veterinary treatment and nursing care are insufficient to restore these animals to the ambulatory state in a timely and humane fashion, the only practical alternatives would appear to be on-farm euthanasia or on-farm slaughter. On-farm slaughter has the advantage of salvaging meat that would otherwise be wasted, and if properly conducted, inspected and regulated, could provide market access for product. Therefore, there is an urgent need for research to investigate the feasibility of, and food safety and animal welfare merits of regulated on-farm slaughter specifically for non-ambulatory animals, as a possible solution to this problem.

(c) Recommendation

We recommend that research be urgently carried out into the feasibility of regulated on-farm slaughter of non-ambulatory animals in Ontario.

6. HACCP

(i) HACCP and Food Safety

(a) Issue

The appropriate role for HACCP in food safety.

(b) Background

HACCP-based food safety has been accepted globally as the “gold standard” for food safety programs. In Canada it is being applied across the food continuum, from the farm through to the consumer, although not with equal degrees of maturity in all sectors. Therefore it seems logical to apply its principles at provincial and local levels. Emphasis to start should be placed at the primary production and processing levels. The raw material for the processor comes from the farm and is an essential ingredient for building a strong HACCP – based food safety program at the slaughter plant. Healthy, clean, well nourished, stress – free animals produce higher quality and safer food products. It is easier to keep safe an already safe product and possibly improve food safety throughout the continuum than it is to build food safety into the product. This is particularly true with fresh, perishable products.
It should be noted that the CFIA and the Canadian Federation of Agriculture, together, have created the Canadian On-Farm Food Safety Program, better known as COFFS. This initiative seeks to involve commodity groups at a national level to individually develop on-farm HACCP-based food safety programs. This project was started in 1997 with funding from Agriculture and Agri-Food Canada. At last count there were 19 commodity groups in various stages of development. Financing is jointly shared between COFFS and the commodity groups. Although the program is still early in its application, one can assume the results will promote the cause of food safety. Government, at all levels, should support this effort.

(c) Recommendation

We recommend that HACCP-based food safety programs should be implemented from production through slaughter and processing to the distribution, retail, and food service sector, through to the consumer sector. An overall framework should be built for the whole food continuum concurrent with the development of the producer and processor programs. The basic framework should be continuous, transparent, user friendly, and easily understood by all.

ii. HACCP Costs

(a) Issue

The relationship between HACCP and the inspection program, and addressing its costs.

(b) Background

Part of any well-constructed food safety program will require collecting information, keeping records, and doing some analyses, much like keeping financial records. As one would hire a bookkeeper/accountant for the financial part, assistance would be needed for the food safety records. This would require some technical training and some help in establishing a system for an individual establishment. While a generic model may be helpful in getting started, some individual assistance may be necessary.

Again, this could be cost-shared with the Province providing the expertise, either through the meat inspector or specialists to help small businesses, and the operator could pay a flat fee or by the hour. Part of the cost to the operator could be the establishment of a small lab to do his/her own testing or to pay for sending samples out to a private lab. The testing program could be simple (after all, many are small or very small businesses), but effective. Part of the training would include how the operator would set up an effective testing program and how he would use it to support his food safety program. The Province would also have a responsibility to maintain valid baseline studies. This would enable individual establishments to evaluate how well each was doing against the “ Provincial Mean”. For example, is the establishment average and/or in what percentile? This would be one measure of performance. The “Provincial mean” could also be compared against the “Federal mean” to see how well the Province was doing nationally. It would be the responsibility of the various government jurisdictions to maintain valid and current baselines.

In addition to the baseline and establishment performance data, national and provincial surveillance systems are needed. Both the incidence of human illnesses due to food pathogens and investigative data (commodity, pathogen, source of occurrence, etc.) are required to measure the
effectiveness of federal and provincial food safety programs. These data need to be collected and summarized on a timely basis so yearly progress and cost effectiveness of programs can be measured. Funding should be from the respective governments.

Integration of a HACCP-based food safety program with the inspection program will facilitate cost effectiveness and some efficiencies in the system. The funding for the development, establishment, and implementation should come from the provincial government. The cost of maintenance (includes auditing/verification) and training should be shared. For example the Province could develop the audit and training programs, but industry would pay to take the course(s) and for the annual audit process. Incentives for the industry to pay some of the costs would be increased consumer confidence in their products, expanded marketing development and opportunities, e.g. schools, hospitals, etc., and a safety net (insurance policy) for their business to help protect against risk, crises, and other losses. It is believed that having a recognized and validated food safety program will also reduce the cost of liability insurance.

(c) Recommendation

We recommend that the HACCP-based food safety program be completely integrated with the inspection program, and that there be cost-sharing by the industry and the Province, particularly in the areas of training and auditing.

iii. Should HACCP be voluntary?

(a) Issue

Should HACCP-based programs be voluntary or mandatory?

(b) Background

A phase-in period for compulsory HACCP-like program implementation would allow for undecided meat plant operators to decide if they wanted to stay in business and adopt the food safety program or consider some other type of business. Following the grace period, a mandatory program would be implemented over a three year period with the medium size plants required to have a program at the end of the first year, followed by small ones at the end of two years, and very small ones at the end of three years. One requirement for licenced plants could be to process animals from only farms with recognized on-farm food safety programs. This would encourage the adoption of such programs. Special consideration could be given for those farms that don’t have a program, e.g. custom slaughter, hobby farms, etc., but tighter rules with more “inspector” supervision at an additional cost would apply.

Third party audits could be conducted on a yearly basis paid for by the operator. The meat inspector would conduct partial audits on a regular basis and monitor the implementation and maintenance of the food safety program. The same would also have the authority to issue CAR’s (corrective action requests) when deviations occurred and the responsibility of seeing that the CAR’s are completed. The ultimate authority from enforcement of the food safety program would be that of the meat inspector, his/her supervisor and the Ontario Ministry of Agriculture and Food.
(c) Recommendation

We recommend that the HACCP-based programs should be mandatory for all licensed provincial meat plants, including all free standing meat processing plants. There would be a phase-in period of three to five years depending on the grace period during the initial implementation, which might last up to two years.

CONCLUSIONS

We have examined meat inspection in Ontario with regard to its scientific basis, regulatory structure and capabilities, and have identified a number of strengths and weaknesses. Overall, we conclude that Ontario’s current meat regulatory and inspection regimes are based on sound scientific principles, and are providing a reasonable level of public health and safety to the citizens of the Province. Nevertheless, diseases associated with food animals and their products remain important public health problems in the Province, and recent global trends suggest that new and perhaps more serious foodborne diseases are likely to emerge in the future. Furthermore, BSE and other food safety issues in Canada and abroad have raised public concerns and expectations concerning food safety to new levels, and these are having dramatic impacts on food animal production, processing, marketing and waste disposal. In order to keep abreast of these developments, to better address foodborne disease, and to ensure a comprehensive, science-based food safety system that is capable of managing the problems of tomorrow, the strengths of the current regimes must be maintained and the deficiencies that exist in certain areas must be addressed.

Our recommendations cover a broad range of issues but six over arching themes emerge:

1. Science capacity

Food safety systems must be firmly based on sound science for the efficient and effective management of food safety problems, protection of public health and maintenance of consumer and business confidence. These systems should adhere to good risk analysis principles, and should have adequate scientific expertise and laboratory capacity to support policy development and programs. The current inspection regimes are solidly based in risk analysis and have been aggressively and appropriately using research, baseline studies and risk assessments to support the meat inspection, HACCP, and other programs that are intended to improve food safety. It is critical to maintain a high-quality food safety science capacity in Ontario that is based on solid research, surveillance and risk analysis.

2. Surveillance

Food safety surveillance is the timely collection, analysis and dissemination of foodborne disease and food hazard data. High-quality surveillance is critical in order to identify foodborne disease trends and emerging problems, identify and minimize the impact of outbreaks, prevent spread to larger populations, and to plan and evaluate food safety programs (e.g. HACCP, inspector and food handler training programs). In addition to surveillance of foodborne diseases, there is continued need for surveillance of hazards throughout the foodchain through ongoing monitoring, as well as periodic baseline or targeted studies. These data should support risk analysis and be used to develop food safety criteria. The current foodborne disease surveillance system is fragmented and relies on outdated methodologies. There is need for improved foodborne disease reporting, more resources for timely data analysis, interpretation and dissemination to those that need to know (e.g. enhanced computer systems,
new technologies, more epidemiological expertise), and for better coordination among responsible
officials at the provincial level, and among provincial and federal partners in foodborne disease control.

3. A Farm-to-Fork Approach

Meat inspection used to be limited to carcass-by-carcass evaluation of animals at slaughter and a
“command and control” approach to regulation in slaughterhouses, instead of focusing on prevention. However, it is now known that foodborne contaminants cannot be “inspected out” at slaughter or any
other single point in food production or processing, and that quality and safety must be built into the
process of food production. Therefore, in this report we have taken a much broader view of meat
inspection systems, and conclude that food safety controls are needed throughout the farm-to-fork
continuum. But the responsibility lies not only with government; industry and the public also have
important roles to play. Food safety programs based on the HACCP system and Good Production /
Manufacturing Practices should be encouraged throughout the farm-to-fork continuum. These should be
designed with specific public health objectives in mind, and be guided by surveillance and risk analysis.

4. Regulatory Flexibility

The remarkable success in controlling many foodborne diseases must be considered as one of the
great achievements of public health in the 20th century. Food-safety regulatory agencies have almost
eradicated human disease and deaths from bovine tuberculosis, brucellosis and botulism from commercial
products, for example, but several more recent factors, such as increases in world food trade, new
emerging pathogens, the role of food processing operations and the aging population have combined to
create major new challenges. Even if all of our recommendations are implemented and adequately
resourced, food-safety regulators will have to have the resources and ingenuity to adapt to changing
circumstances and to constantly strive to stay current. Our report deals with a number of matters that
were not even seen as issues two years ago and the pace of change will not diminish. The regulatory
system must be flexible and responsive to cope with new challenges and scientific change.

5. Human Resources

A regulatory system can only be a good as the people implementing it. That means that the
public servants at all levels of the meat inspection system need to be adequately resourced, well trained
and have a clear understanding of their roles. To overcome some of the problems of the past and to meet
the challenges of the future, managers of the meat inspection system at all levels will have to provide
strong leadership in human resources management.

6. Working Together

Meat safety, like food safety more generally, is necessarily a shared responsibility all along the
food chain from the producer to the consumer and across all levels of government. The current inspection
regimes are active at these levels, but there is need for greater integration and coordination of government
activities and programs. The meat inspection system must be a real system that provides for timely
sharing of information to ensure comprehensive and coordinated emergency planning and response.
Strong inter-agency coordination is a sine qua non for an effective Ontario meat inspection system.

We therefore respectfully submit the following summary of recommendations:

Recommendations:
1. **We recommend that** the Province of Ontario adopt regulations that are equivalent to the National Meat and Poultry Regulations and Code.

2. **We recommend that** the Food Safety and Quality Act be proclaimed without further delay.

3. **We recommend that** Ontario maintain a high quality food safety science capacity that is based on solid research, surveillance and risk analysis.

4. **We recommend that** the proposed amendments to the Food Premises Regulation be adopted but with a phase in time for mandatory food handler training/certification of no longer than two years for high risk and medium risk establishments.

5. **We recommend that** the Province of Ontario:
   
   v. Establish an **Ontario Food Safety Reporting Centre (OFSRC)**. This Centre would be responsible for coordination for all matters relating to food safety reporting in the Province. The OFSRC would report to the Chief Medical Officer of Health for the Province of Ontario. All Ministries in the Province that have responsibilities in food safety (OMAF, MOHLTC and MNR) would be required to report any data, issues and concerns to the OFSRC. The OFSRC would be equipped with the technology and resources to provide real-time reporting from multiple jurisdictions and analytical and GIS mapping capability. This Centre would provide early warning and coordination to ensure rapid investigation of threats and unusual occurrences in Ontario, risk communication with the public and provide linkages to Federal authorities.
   
   vi. Create the new position of **Chief Veterinary Officer for Ontario** that would have responsibility for meat inspection and animal health within the province.
   
   vii. Implement electronic submission and reporting forms for the food safety investigation samples submitted by Public Health Inspectors that would be comparable to the electronic system currently in place for the Meat Inspection Program of the Food Inspection Branch, OMAF.
   
   viii. Implement the eLEXNET system (or a comparable system) in all food laboratories (Federal, Provincial, and Private) in Ontario. This type of system can extract and integrate data from differing reporting systems.
   
   ix. Carry out a review to determine whether the capacity of the current level 3 containment facilities is adequate to support investigations into emerging pathogens and other sources of foodborne illness and to fund the necessary enhancement.
   
   x. Expand its capacity to conduct testing and research on the causes of foodborne illnesses and on prion related zoonotic diseases such as bovine spongiform encephalopathy (BSE).

6. **We recommend that** the Chief Medical Officer of Health through the Ontario Food Safety Reporting Centre ensure the activation of the Ontario Outbreak Investigation Coordinating Committee (OOICC) for all appropriate food safety situations as designated under the Memorandum of Understanding for Foodborne Illness Outbreak and Hazard Response and Product Recalls, including appropriate food recall situations.
7. **We recommend that** the relevant recommendations of the Interim Report of the Ontario Expert Panel on SARS and Infectious Disease Control, including Recommendations 10, 36, 37, 38, 39, 40, 41 be implemented.

For ease of reference those recommendations are as follows:

(1) **Recommendation 10**

“The Ministry should establish a process to develop regional infection control networks across Ontario with a designated hospital and public health unit as joint leads in the development process. The networks should include but not be limited to public health units, hospital infection control practitioners, emergency health services, long-term care, and community based health care providers.”

(2) **Recommendation 36**

“The Ministry should build on work undertaken to date and develop a comprehensive, provincial infectious disease surveillance plan by June 30, 2004. This work should:

- be carried out by a multi-disciplinary group, which includes scientific, government, information technology and health care partners, and which is accountable to the Minister of Health and Long-Term Care.
- involve aligning and clarifying the roles of post-SARS provincial advisory committees with working groups examining the issue of disease surveillance.
- examine any opportunities or barriers to using existing tools such as Telehealth and Telemedicine.
- include province-wide surveillance for facility-acquired infections.”

(3) **Recommendation 37**

“The Ministry must ensure that an appropriate information technology infrastructure is in place to fully support the provincial infectious disease surveillance plan by June 30, 2004.”

(4) **Recommendation 38**

“The Ministry should expedite the full implementation of the Integrated Public Health Information System (iPHIS), together with any required design modifications, across all Public Health Units in the province by June 30, 2004.”

(5) **Recommendation 39**

“The Ministry must move rapidly to fully implement the necessary information technology supports to allow for contact tracing and quarantine management by Public Health Units by June 30, 2004. If this cannot be accomplished through design modifications to iPHIS, other suitable information technology platforms must be used.”

(6) **Recommendation 40**

“The Ministry should establish a working group with representation from healthcare stakeholders, researchers, and the Ministry to review on an urgent basis all data access and data sharing protocols between Public Health Units, the Ministry, municipalities,
and the federal government. This review should identify how and to whom identifiable personal information is authorized to flow in the event of an outbreak. The working group should submit a report to the Minister by March 31, 2004 outlining the common data sharing structure, reporting relationships, and other common requirements of the data access and sharing protocols.”

(7) **Recommendation 41**

“The Ministry should undertake a detailed legislative review of the Freedom of Information and Protection of Privacy Act and the Municipal Freedom of Information and Protection of Privacy Act in the context of:

- the reporting requirements set out under the Health Protection and Promotion Act.
- identifying potential barriers to the sharing of information in appropriate and timely manner.
- ensuring appropriate protections for personal information.”

8. **We recommend that** the necessary regulatory changes be made to increase the capacity to handle dead stock efficiently and safely. These changes include licensure of on-farm incinerators, composting, central compost and incineration facilities, transfer stations and inclusion of “minor use” species.

9. **We recommend that** the province provide interim financial support to the dead stock industry (collectors, facilities operators) to see it though the present crisis and ensure collections and safe disposal continue in the short term. The industry and the ministry should co-ordinate their planning and resourcing for longer term solutions involving alternative recycling.

10. **We recommend that** producers be allowed to transport their own dead stock to central disposal facilities using appropriate safeguards, and that dead stock can be held longer than 48 hours on farm with proper refrigeration and storage.

11. **We recommend that** dead stock be part of the food safety surveillance system in the province, and that operators keep records that enable traceback.

12. **We recommend that** the province undertake an in-depth study with significant accompanying resources to determine what environmentally sound disposal facilities are needed in Ontario. This would be followed by action to support the development and availability of the recommended processes.

13. **We recommend that** the establishment of a provincial licensing system be established for free standing meat processing plants.

14. **We recommend that** consistent with the provisions of the Ontario Food Safety and Quality Act and its regulations, the Ministry of Agriculture and Food assume responsibility for the inspection of free standing meat processing plants.

15. **We recommend that** where there is overlap in legislated responsibility between the Ontario Ministry of Agriculture and Food and the Ministry of Health and Long-Term Care for the inspection of free standing meat processing plants, a partnership agreement be established to avoid duplication.
16. **We recommend that** adequate staffing and training resources be allocated to ensure inspection standards for free standing meat processing plants are met.

17. **We recommend that** mandatory food handler training be implemented for all medium and high risk food premises consistent with the requirements of the Food Handler Training Protocol of the Food Safety Program of the Mandatory Health Programs and Services Guidelines of the Health Protection and Promotion Act and this includes the medium and high risk facilities within the provincially licenced abattoirs.

18. **We recommend that** mandatory food handler training be phased in over a two-year period, with recertification every five years.

19. **We recommend that** the province develop a HACCP-based food safety system and provide HACCP training to all its inspectors and establishment operators following the same program where appropriate.

20. **We recommend that** existing food safety informational strategies be evaluated for effectiveness and that new informational campaigns be researched and developed to more effectively compel consumers to practice safe food handling and exercise safe food choices in the home.

21. **We recommend that** all sectors in the meat industry develop effective food safety traceability systems.

22. **We recommend that** all commodity groups develop programs for the transfer of relevant animal health and on-farm food safety information that would accompany animals sent from farm to slaughter.

23. **We recommend that** regulations concerning ante-mortem and post-mortem inspection, and SRM removal be strictly enforced, monitored, and be fully incorporated within HACCP-like food safety programs. Additional measures should be considered in the interests of public and business confidence concerning BSE risks from downers, with recognition of the implications of these additional measures.

24. **We recommend that** research be urgently carried out into the feasibility of regulated on-farm slaughter of non-ambulatory animals in Ontario.

25. **We recommend that** HACCP-based food safety programs should be implemented from production through slaughter and processing to the distribution, retail, and food service sector, through to the consumer sector. An overall framework should be built for the whole food continuum concurrent with the development of the producer and processor programs. The basic framework should be continuous, transparent, user friendly, and easily understood by all.

26. **We recommend that** the HACCP-based food safety program be completely integrated with the inspection program, and that there be cost-sharing by the industry and the Province, particularly in the areas of training and auditing.

27. **We recommend that** the HACCP-based programs should be mandatory for all licensed provincial meat plants, including all free standing meat processing plants. There would be a phase-in period of
three to five years depending on the grace period during the initial implementation, which might last up to two years.
APPENDIX 1. BIOGRAPHICAL SKETCHES OF EXPERT ADVISORY PANEL MEMBERS AND WORKSHOP PARTICIPANTS

**Expert Advisory Panel**

**Ronald L. Doering, B.A., LL.B., M.A., LL.D.,** (Co-chair), is the former President of the Canadian Food Inspection Agency and now practices law with the Government Relations and Regulatory Affairs Group in the Ottawa offices of Gowling Lafleur Henderson LLP where his practice is primarily in the areas of agriculture and food law, environmental law and public health law and policy. He has had over 30 years experience in law and public administration. Before joining Gowlings, he held a number of senior positions in the federal government. He has written and lectured widely on law and public policy, most recently on environmental regulations, food safety, biotechnology regulations, regulatory reform and risk management. He is an adjunct Professor, Ontario Agricultural College, University of Guelph.

**Scott A. McEwen, D.V.M., D.V.Sc., Diplomate A.C.V.P.,** (Co-chair), is a Professor in the Department of Population Medicine, Ontario Veterinary College, University of Guelph. Dr. McEwen obtained his DVM and Doctor of Veterinary Science degrees from the University of Guelph. His research focuses on the epidemiology of foodborne infections in food animal populations, particularly *E. coli* and antimicrobial resistant organisms, but also *Salmonella* and other pathogens. He has extensive experience in conducting epidemiological studies of food safety hazards in cattle, swine and other food animal species, as well as risk facts of foodborne illness in humans. Since 1986 Dr. McEwen has taught food safety to veterinary students and graduate students in a variety of degree programs and has been the principal research advisor of over 25 graduate students. He is author or co-author of over 95 publications in refereed scientific journals. He consults on food safety, antimicrobial resistance, epidemiology and other veterinary public health matters with a number of governmental and non-governmental organizations in North America and Europe, notably various food animal industry groups, Health Canada, the Alliance for the Prudent Use of Antibiotics, the United States Food and Drug Administration, and the World Health Organization.

**Robert Clarke, B.Sc., D.V.M., Ph.D.,** is currently Visiting Professor of Epidemiology and Community Medicine in the Faculty of Medicine at the University of Ottawa. He also serves as the Executive Director of the McLaughlin Center for population health risk assessment in the Institute of Population Health. Prior to joining the University of Ottawa, Dr. Clarke was Executive Director of Laboratories for the Canadian Food Inspection Agency. In this position he was responsible for one of the largest national laboratory systems in Canada, comprising over 800 personnel at 16 sites. In previous positions Dr. Clarke managed scientific programs at Health Canada, and Agriculture and Agri-food Canada. He obtained his Doctor of Veterinary Medicine degree in 1976 and a Ph.D. in Veterinary Microbiology in 1985 from the University of Guelph.

**Mansel Griffiths, B.Sc., Ph.D.,** holds an Industrial Research Chair in Dairy Microbiology in the Food Science Department at the University of Guelph. He is Program Chair for the M.Sc. in Food Safety and
Quality Assurance being offered at Guelph and is the Director of the Canadian Research Institute for Food Safety, a research collaboration between federal and provincial government and the University of Guelph. His current research interests include rapid detection of foodborne pathogens; factors controlling growth and survival of microorganisms in foods; and beneficial uses of microorganisms. Dr Griffiths has authored more than 200 peer-reviewed articles and been the supervisor for 35 completed theses by graduate students. He is an Associate Scientific Editor of the Journal of Food Science, a member of the Executive Editorial Board of Journal of the Science of Food and Agriculture, and serves on the editorial boards of Food Research International, Journal of Food Protection, International Journal of Food Microbiology, Applied Biotechnology, Food Science and Policy and Foodborne Pathogens and Disease. He is a member of the International Dairy Federation working group on milk-borne pathogens and serves on the Expert Scientific Advisory Committee for Dairy Farmers of Canada. He serves as the External Examiner for the Bachelor of Science and Food Technology program at the Universiti Putra, Malaysia and as a Member of the College of Reviewers for the Canada Research Chair Program. He was the G. Malcolm Trout visiting scholar at Michigan State University in 1999 and was the recipient of the International Association of Food Protection Maurice Weber Laboratorian of the Year for 2002.

David McEwen, D.V.M., is President of McEwen Agri-Consulting Inc., consultants to the agriculture and food sectors. A veterinarian, he has extensive experience in both the federal and provincial regulatory agencies. Since founding the company six years ago, he has been directly involved in food safety systems from a planning, development and maintenance perspective in a variety of industries including livestock, meat processing, dairy and wine. His experience includes 15 years with the Canadian Food Inspection Agency, with responsibilities in both Meat Hygiene and Animal Health. More recently Dr. McEwen conducted audits in provincial abattoirs and assisted OMAF with changes in community sales and deadstock programs. He has provided HACCP guidance to both governments and industry, including HACCP on-farm programs (Canadian On-Farm Food Safety Program) as well as the meat processing sector. Prior to joining CFIA, he owned and operated a veterinary practice for a number of years. Dr. McEwen obtained his Doctor of Veterinary Medicine degree from the University of Guelph.

Graham L. Pollett M.D. M.H.Sc, FRCPC, FACPM, is Medical Officer of Health and Chief Executive Officer for the Middlesex-London Health Unit. He has over twenty years of rural and urban public health experience, having served in the past as Medical Officer of Health for the Region of Halton and the City of North York. A graduate of Dalhousie University Medical School, Dr. Pollett completed a residency in community medicine at the University of Toronto. He was Director of the Community Medicine Residency Program at the University of Toronto from 1989 – 1991. Dr. Pollett is adjunct Professor, Departments of Family Medicine; and Epidemiology and Biostatistics, University of Western Ontario.

Douglas Powell B.Sc., Ph.D., is currently an Associate Professor in the Department of Plant Agriculture at the University of Guelph, and Director of the Food Safety Network, where he leads a diverse research team that integrates scientific knowledge with public perceptions to garner the benefits of a particular agricultural technology or product while managing and mitigating identified risks. Dr. Powell completed a BSc (honors) in Molecular Biology and Genetics at the University of Guelph in 1985, and a Ph.D in the Department of Food Science at the University of Guelph in May 1996, applying risk communication theory to issues of food safety and agricultural biotechnology. Dr. Powell is a consultant for industry and government, is a frequent speaker on public issues of science and society, and continues as a freelance...
journalist. His first book, Mad Cows and Mother's Milk, co-authored with Bill Leiss of Queen's University, was published by McGill-Queen's University Press in Oct. 1997.

W. Ronald Usborne B.Sc., M.Sc. Ph.D., P.Ag. is Vice-President of Quality Assurance, Food Safety, and Technical Services, Caravelle Foods, Brampton Ontario. Formerly he was Professor of Animal Science/Food Science at the University of Guelph where he also served as Chair of the Department of Food Science. Over the past few years while at Caravelle Foods he has spent a significant amount of time working on food safety and advising raw material suppliers on applying HACCP – based food safety programs and humane handling in their slaughter and boning operations. Dr. Usborne has been recognized by the Ontario Food Protection Association and the Canadian Meat Council for his technical contributions to food safety and the advancement of meat science and service to industry, government, professional committees, and organizations. He was awarded a lifetime membership by the Ontario Independent Meat Processors in 1996. Currently he serves on a number of academic, government, and industry advisory boards, committees, and councils.

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John Blatherwick, M.D., has been the Medical Health Officer in Vancouver since March 1984 and is the Chief Medical Health Officer of the Vancouver Coastal Health Authority. Prior to coming to Vancouver, he was the Medical Health Officer in the Simon Fraser Health Unit for nine years. He started in public health with the Vancouver Health Department in 1971, leaving a residency in Internal Medicine at Vancouver General Hospital to set up the Pine Street Youth Clinic. He left Vancouver in 1974 to take his Diploma in Public Health at the University of Toronto and to complete his Fellowship in Public Health at UBC. Dr Blatherwick served in the Canadian Forces reserves for 39 years in total retiring in 2000. He retired with the rank of Commander and was the Senior Naval Reserve Medical Advisor when he retired. He was Canada’s representative to the NATO Reserve Medical Officers’ Congress from 1989 to 1995 and received only their sixth gold medal. Dr. Blatherwick has published 18 books, mainly about airplanes and about civilian and military medals. Dr. Blatherwick was awarded the Order of Canada in 1994 for his work in public health and received an award as a Canadian Health Hero from the Pan American Health Organization in 2002.

Larry Copeland, is Director, Food Protection Services, British Columbia Centre for Disease Control, Ministry of Health, British Columbia. Mr. Copeland’s office is responsible for providing the Ministry of Health with the scientific advise the Ministry requires to develop provincial policy and legislation governing the safety of the province's food supply. As well it provides similar specialized scientific resources to the regional Health Authorities to assist them in their mandate of administering/enforcing provincial food safety policy and legislation within their jurisdiction. Additional related services include undertaking necessary research, providing education/training programs, develop information management programs and collect/analyze data concerning foodborne hazards/illnesses contributing to the burden of morbidity and mortality in the British Columbia population. Mr. Copeland’s office is as well directly responsible for administering the provisions 3 provincial food safety Acts governing abattoirs, dairy and fish processing plants. This includes provision of licensing, inspection and enforcement services to support the regulatory requirements under these Acts.
Gordon Dittberner, B.V.Sc., is a veterinary science graduate of the University of Pretoria. After leaving South Africa in 1966, he practiced in the United Kingdom for almost a year and then immigrated to Canada. He was a partner in a small animal practice in Calgary for 6 years, before beginning his career with Agriculture Canada as a field veterinarian in the Calgary District Office in 1974. In 1977 he moved to Ottawa where he accepted a variety of positions with Agriculture Canada related to regulatory veterinary medicine. In 1986 he was appointed the Veterinary Director General and then in 1991 the Assistant Deputy Minister, Corporate Services Branch, Agriculture and Agri-food Canada. In 1998 Dr. Dittberner retired from the federal government and founded AgriVet International, specializing in agriculture, veterinary and management consulting. His clients have included Health Canada, Agriculture and Agri-food Canada and the Canadian Veterinary Medical Association, as well as the National and Provincial Departments of Agriculture in South Africa.

Pat Dodsworth, is Director, Quality Assurance and Food Safety, Schneider Foods.

Kathryn Doré, B.Sc., M.H.Sc., is Senior Epidemiologist and A/Manager: Surveillance Section, Foodborne, Waterborne and Zoonotic Infections Division, Health Canada and Adjunct Professor, Department of Population Medicine, University of Guelph.

Sandra Fulton, is President, Fulton Food Safety Consultants, Rockwood, Ontario, a firm that specializes in regulatory requirements for the food industry and provides practical ‘hands-on’ services to industry and government in HACCP development, auditing, on-site-training, plant design and federal approvals. In 2002-03, her firm developed and delivered Further Meat Processing training to OMAF’s inspection staff, and developed the HACCP approach (standards) for OMAF’s HACCP Advantage Program. Ms. Fulton started her career with CFIA in 1980 as a federal meat inspector and worked progressively to the position of Area Supervisor for meat processing inspectors. Prior to resigning her position in 1998, Sandra held the position of Program Specialists, Blueprints, Plants and Equipment for the Ontario Region and was responsible for licensing, evaluating blueprints, enforcement, providing interpretation and direction to industry and inspection staff on standards, training inspection staff and auditing 60 establishments annually for compliance. In 1999, Ms. Fulton was contracted by the CFISIG to develop the 16-chapter Code for the National Meat & Poultry Regulations.

John Groenewegen, Ph.D., is President of JRG Consulting Group, a firm dedicated to providing consulting services to the agri-food sector. Dr. Groenewegen has a key role in providing consulting services to governments, industry associations and agri-business firms on issues such as business strategy, competitiveness, farm policy, trade policy, grain sector issues, horticultural, and livestock and poultry sector issues. In the food safety area, he has been involved in projects related to the costs of compliance with meat standards by abattoirs, developing an inventory of freestanding meat plants, reducing the barriers to HACCP adoption in the meat industry, and an audit of a food safety program. Dr. Groenewegen was a Partner with Deloitte & Touche Consulting Group responsible for the agri-food consulting practice (focusing on strategy, economics and policy issues). Prior to his consulting career, Agriculture Canada employed him as a policy analyst, and was on staff at the United States Department of Agriculture in agricultural policy. Dr. Groenewegen obtained his Ph.D. in Agriculture and Applied Economics from the University of Minnesota, and his B.Sc. (Agr) and M.Sc. in Agricultural Economics from the University of Guelph. John is also a Certified Management Consultant (CMC).
Sylvain Quessy, D.M.V., Ph.D., is Industrial Chair on Meat Hygiene, Associate Professor, Département de pathologie et Microbiologie, Faculté de médecine vétérinaire, Université de Montréal. Dr. Quessy is a graduate of the University of Montreal (DVM, 1984). He worked as a private practitioner and as a meat hygienist for Canadian Food Inspection Agency (CFIA) before the completion of his PhD in microbiology and immunology (Montreal, 1994). He then worked for Health Canada as scientific researcher and head of environmental microbiology section of the Heath of Animals and Food Laboratory at St-Hyacinthe where he studied the molecular epidemiology and the control of food-borne and water-borne pathogens. In 1999, he accepted a position as professor at the Faculty of Veterinary Medicine of the University of Montreal. He is currently responsible of a research chair in meat safety where he supervises the worked of many graduate students, working on the genetic characterization and epidemiology of foodborne and environmental pathogens. He acted as scientific counsellor for many governmental, professional or producer organizations in the development of policies, of on-farm HACCP-based models, or in risk analysis. He is recognized as an expert in microbial risk assessment by the Word Health Organization. He published and presented numerous scientific papers on the molecular epidemiology, pathogenesis and control of pathogens such as *Salmonella*, *Yersinia*, *Cryptosporidium* and *Campylobacter*.

Bill Rannells, D.V.M., is an independent Contractor, Cook and Thurber, Ann Arbor, Michigan. Former Industry QA Manager and USDA Cooperative State-FSIS official.

Robin Williams, M.D., is the Medical Officer of Health for the Niagara Region and a Clinical Professor at McMaster University. Apart from being responsible for general public health programs including water and food safety, Dr. Williams and her staff were involved in an *E. coli* 0157:H7 foodborne investigation in Regional Niagara in the Spring of 1998 involving 39 patients. This was subsequently sourced to Genoa salami and the case control study was published in the Canadian Medical Association Journal.

Peter Willmott, MES,CPHI(c), is currently the Director, Health Protection Services, with the Halton Region Health Department, Oakville, Ontario, a position he has held since 1985. Prior to that time, he was employed by the Ontario Ministry of Health for 12 years in a variety of positions, including Chief of the Provincial Public Health Inspection Service and Co-ordinator of Public Health Legislation. In this latter capacity, he was one of the principal authors of the Health Protection & Promotion Act. From 1983 – 1995, Mr. Willmott taught environmental health management in the School of Occupational & Public Health, Ryerson University. Mr. Willmott’s current portfolio includes responsibility for the Health Department’s Communicable Disease Control and Food Safety Programs. His current interests in food safety include membership in the Canadian Food Inspection System Implementation Group and the Ontario Food Safety System Implementation Committee. Mr. Willmott trained as a public health inspector in the UK and Canada. His UK qualifications include certification as a meat inspector. He is a graduate of the School of Business & Economics, Wilfred Laurier University and holds a Master’s Degree in Environmental Studies from York University. He is currently completing a PhD in Food Safety Policy from the University of Lincoln (UK).
**Expert Advisory Panel Assistants**

**Richard Arsenault, D.M.V.,** is currently on secondment from the CFIA to Guelph, Ontario in order to complete a M.Sc. in veterinary epidemiology in the Department of Population Medicine, University of Guelph. He is conducting research on *Salmonella* and *Campylobacter* in Ontario broiler chicken flocks. Dr. Arsenault received his degree in veterinary medicine from the University of Montreal in 1987 and after 2 years of small animal practice, moved to British Columbia to join the federal meat inspection service. He worked in various provincially and federally registered slaughter plants in that province until 1991 when he was promoted to a national headquarters position with the CFIA. Before entering his current graduate program he was involved in a number of national meat inspection programs, including the Food Safety Enhancement Program, and auditing of federally inspected establishments.

**David Pearl, D.V.M, M.Sc.,** is currently a PhD candidate in the Department of Population Medicine at the University of Guelph. Dr. Pearl obtained his DVM from the University of Guelph in 2001. His doctoral research training is being funded through a fellowship from the Canadian Institutes of Health Research. He is studying the epidemiology of *E. coli* O157:H7 among humans in Alberta, and his research integrates the use of spatial statistics, molecular epidemiology, and multi-level modelling for answering epidemiological questions and improving surveillance systems. His research interests include disease surveillance, and the epidemiology of zoonotic and foodborne disease. As a guest lecturer and teaching assistant, he has instructed undergraduate and graduate students in epidemiology and zoonotic disease related courses.
APPENDIX 2. WEB LINKS TO ACTS AND REGULATIONS CITED IN REPORT

III. PROVINCIAL (ONTARIO)

1) Dead Animal Disposal Act, R.S.O. 1990, c.D.3
   http://192.75.156.68/DBLaws/Statutes/English/90d03_e.htm

2) Food Safety and Quality Act, 2001, S.O. 2001, c. 20
   http://192.75.156.68/DBLaws/Statutes/English/01f20_e.htm

3) Health Protection and Promotion Act, R.S.O. 1990, c. H.7
   http://192.75.156.68/DBLaws/Statutes/English/90h07_e.htm
         http://192.75.156.68/DBLaws/Regs/English/900557_e.htm
      b. Food Premises, R.R.O. 1990, Reg. 562
         http://www.e-laws.gov.on.ca/DBLaws/Regs/English/900562_e.htm
      c. Mandatory Health Programs and Services Guidelines, pursuant to s.7 of the Health
         Protection and Promotion Act, R.S.O. 1990, c. H.7
      d. Qualifications of Boards of Health Staff, R.R.O. 1990, Reg. 566 http://www.e-
         laws.gov.on.ca/DBLaws/Regs/English/900566_e.htm

4) Livestock and Livestock Products Act, R.S.O. 1990, c. L.20
   http://192.75.156.68/DBLaws/Statutes/English/90l20_e.htm
   a. Transporting Non-Ambulatory Animals, O. Reg. 732/94
      http://www.e-laws.gov.on.ca/DBLaws/Regs/English/940732_e.htm

5) Livestock Community Sales Act, R.S.O. 1990, c. L.22
   http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90l22_e.htm

   http://192.75.156.68/DBLaws/Statutes/English/90m05_e.htm
   a. General, O. Reg. 632/92
      http://www.e-laws.gov.on.ca/DBLaws/Regs/English/920632_e.htm

7) Nutrient Management Act, 2002, S.O. 2002, c. 4
   http://192.75.156.68/DBLaws/Statutes/English/02n04_e.htm

8) Emergency Management Act, R.S.O. 1990, c. E.9
   http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90e09_e.htm
IV. FEDERAL

   http://www.cfis.agr.ca/english/regcode/nmprc/nmprc_regs_idx_e.shtml

    http://www.cfis.agr.ca/english/regcode/nmprc/nmprc_idx_e.shtml

11) *Health of Animals Act*, S.C.1990, c. 21