SIX STEPS TO SAFETY

Taking Charge:
Transforming Today's Science Into Tomorrow's Prevention

Plan of the Canadian AgriSafety Applied Science Program: National Consultation and Applied Science Initiatives

Agrivita Canada Inc.

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creod Centre for Research Expertise in Occupational Disease

AGRIVITA CANADA

CCHSA / CCSSMA

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WHO WE ARE

AGRIVITA CANADA INC. (AGRIVITA)

Agrivita is a national incorporated not-for-profit company. Agrivita is committed to ensuring that farmers and agricultural workers have a standard of occupational health and safety equivalent to other industries, that the health of agricultural employees and neighbours is protected and that there is a positive relationship between agriculture and public health. Agrivita Canada has been established to:

- Promote safety and health research and development in Canada
- Provide coordination and management for the Canadian AgriSafety Program as a national program of research and development aimed at managing risk of injury and death in Canadian agriculture

Visit us at http://agrivita.ca/

IN PARTNERSHIP WITH

THE CANADIAN CENTRE FOR HEALTH AND SAFETY IN AGRICULTURE (CCHSA)

CCHSA at the University of Saskatchewan is Canada's only diversified agricultural health and safety organization with the mandate of conducting and stimulating research, education, service and prevention programs for farmers and rural communities.

- Outstanding scientists addressing safety and health issues critical to Canadian agriculture
- Training program aimed at developing the next generation of Canadian scientists
- Network of researchers across Canada providing geographic breadth and scientific depth
- *National Industrial Hygiene Laboratory,* a national research and development hub
- Knowledge translation leadership with a mailing list of 30,000

Visit us at http://www.cchsa-ccssma.usask.ca/

NATIONAL COLLABORATORS

THE CENTRE FOR RESEARCH EXPERTISE IN OCCUPATIONAL DISEASE (CREOD)

CREOD is a collaborative program of the University of Toronto and St. Michael's Hospital.

- Dedicated to improving understanding and prevention of occupational disease
- Involved in supporting the Canadian AgriSafety Program through National Consultations

Visit us at http://creod.on.ca/

THE STAKEHOLDERS

Consultations with stakeholders, including producers, industry representatives, researchers, policy makers, program delivery professionals and private sector supporters, have provided valuable insight and recommendations which are contained in this report.

INTRODUCTION

The purpose of this report is to provide information on the current priorities for applied research in agricultural safety and health in Canada. The report is based on a multi-stage, National Consultation process (see Table 1) to assist stakeholders in devising research and development projects for potential funding under Agriculture and Agri-Food Canada's (AAFC) *Canadian Agricultural Partnership.* Funding will be sought for the Canadian AgriSafety Applied Research Program of Agrivita Canada Inc.

The Canadian AgriSafety Applied Research Summit in 2012 involved principle stakeholders from across Canada. At that time, key priorities for applied research in agricultural safety and health were developed.

Building on the output of the 2012 Summit, the Canadian AgriSafety Applied Research Program: A Program for Research and Development was developed by Agrivita Canada Inc. Three of seven proposed projects were funded in 2014 by AAFC through the Industry-Led Research and Innovation Stream. Stakeholders from five provinces are involved with these projects that are currently nearing completion.

In 2015, research at the Canadian Centre for Health and Safety in Agriculture demonstrated that when farmers used the Hierarchy of Control, injury rates are reduced three-fold[1]. The Hierarchy of Control has been commonly used in industry but not in agriculture. As a result, the decision was made to structure further consultation in the context of the Hierarchy of Control. For the first time, this provides a rigorous scientific structure on which to approach what has been a devastating and difficult problem.

In June 2016, stakeholders were again called together to identify priorities as part of the National Summit on the Control of Agricultural Injury and Death in Canada within the framework of the Hierarchy of Control. The Summit was organized by Agrivita Canada with the Canadian Centre for Health and Safety in Agriculture and Centre for Research Expertise in Occupational Disease.

In September 2016, the recommendations of the National Summit were further refined at a meeting sponsored by Ontario Workplace Safety and Prevention Services.

This process has resulted in a set of priorities for applied research in agricultural health and safety in Canada in the context of the Hierarchy of Control, which can be found in this report.

The goal is to arrest the tide of agricultural injury and death in Canada by for the first time adopting a comprehensive planned approach through proven methods of injury reduction by research that brings knowledge directly into priority areas in the workplace.

[1] Dosman J, Hagel L, King N, Koehncke N, Kirychuk S, Trask C, Neudorf J, Day L, Voaklander D, Pickett W. The hierarchy of control in the epidemic of farm injury. *J Agromed*. 2015;20:360-9.

LETTER FROM THE CO-CHAIRS OF THE 2016 SUMMIT

Following in the footsteps of the 2012 Summit, the National Summit on the Control of Injury and Death (National Summit) in Canada brought together stakeholders from across Canada to further develop an applied research strategy to address health and safety challenges in key areas of agriculture. While there has been some reduction in the rates of injury, death and illness in Canadian agriculture, the numbers continue to remain unacceptably high. Other industries have been successful in reducing the rates of workplace injury and death through education, occupational hygiene programs, technological advances and engineering controls, but agriculture remains an area with persistently high injury and death rates despite extensive educational efforts.

Building on the foundation of the *Canadian AgriSafety Applied Research Program: A Program for Research and Development* and the 2012 Summit, the National Summit held on June 7, 2016 brought together producers, researchers, government policy leaders, industry representatives, prevention workers and farm safety groups from 8 provinces and 3 states to redefine priorities for applied research in the agricultural sector. The purpose of the 2016 National Summit was to develop a blueprint for action seeking a transformative approach to the elimination of farm injury in Canada, through the creation of the *Canadian AgriSafety Applied Science Program*: *Transforming Today's Science Into Tomorrow's Prevention.*

Participants focused their discussions on the *Six Steps to Safety*, a framework of hazard reduction and elimination strategies based on the Hierarchy of Control. The Hierarchy of Control has been successfully applied to other high risk industries and has the potential be an effective tool for reducing agricultural workplace injury and death. Stakeholders identified current priorities and research objectives to redefine the applied research agenda for Canada, by outlining steps for the next phase of action and applying the *Six Steps to Safety* to each priority area. Discussions not only worked towards identifying priorities for applied research, but strengthened collaborations between researchers, producers, industry personnel, and government policy leaders from across the country to enhance the development of agricultural health and safety in Canada.

The recommendations of the National Summit are summarized in this document with a blueprint for action for the continued development of an applied research agenda in Canada for agricultural health and safety research. Priorities for action were identified through the combined efforts of all stakeholders working together to utilize the Hierarchy of Control with the ultimate goal of reducing and eliminating death and injury in Canadian agriculture. The result of achieving this essential goal will contribute enhanced production efficiency and establish Canada as a leader in agricultural health and safety.

We invite your participation and thank you most sincerely for your support of this exciting and essential initiative.

Sincerely,
Summit Co-chairs,

Ray Orb,
President
Saskatchewan Association of Rural Municipalities

Carla Warnyca
Manager of Community Investment
Farm Credit Canada

ROLE OF THE CANADIAN AGRISAFETY PROGRAM

THE ISSUE: Agriculture is one of the most dangerous industries in Canada.

- 2,324 people were killed on Canadian farms 1990-2012[1].
- 1,360 people were severely injured each year.
- Hazard classes: injuries and deaths on machines, musculoskeletal, fertilizer and pesticides, particulate and dusts, noise, vibration, buildings and confined spaces, viruses, molecular and disease, weather and the environment, children, older workers, seasonal and migrant workers, production systems and animal handling.
- Cost estimates: injuries $300 million/year.
- Death rates resistant to change.

THE GAP: A lack of applied research to address this issue exists in Canada.

- Canada has education programs supported by public and private sectors.
- Education alone will not stop the toll of death and injury.
- Triad of education, engineering and occupational hygiene is required.
- Canada must have an organized applied research and development program to discover engineering controls and occupational hygiene programs.

NATIONAL CAPABILITY: A National interdisciplinary approach is required.

- Tremendous research and development capability: the Canadian Centre for Health and Safety in Agriculture
- National Industrial Hygiene Laboratory with central node at University of Saskatchewan and branches at Dalhousie, Laval and Queens
- Centre for Research and Education in Occupational Diseases, University of Toronto.

POLICY IMPLICATIONS: Productive, sustainable agriculture requires safe working conditions.

- Enhanced agricultural safety, sustainability, and productivity.
- Lives saved and injuries prevented.
- New products and patents.
- World leadership: Canada joins UN and USA in addressing issue.
- *"It's the right thing to do"*. (Quoted with permission from the late Mr. Lorne Martin, ADM, Manitoba Agriculture Food and Rural Development.)

SUCCESS: The Canadian AgriSafety Applied Research Program 2014 to 2018

- Supported in 2014 by contributions from Agriculture and Agri-Food Canada under the *Industry-led Research and Innovation Stream* of the *Agri-Innovation Program of Growing Forward II*.
- Three of seven proposed projects received matching funding; providing advanced applied research, while at the same time proving themselves as an excellent pilot project for the *Canadian AgriSafety Science Program: Today's Innovation to Tomorrow's Prevention* – proposed for 2018 to 2023.

[1]Canadian Agriculture Injury Reporting (CAIR), Agricultural Fatalities in Canada. CAIR: University of Alberta. (2016). Retrieved from http://www.cair-sbac.ca/wp-content/uploads/2017/02/CASA-CAIR-Report-English-FINAL-Web.pdf

HIGHLIGHTS: The Canadian AgriSafety Applied Research Program – 2014 to 2018

1. PROGRAM MANAGEMENT
- Demonstrated that private sector matching is secured for applied research projects.
- Operated in accordance with AAFC guidelines for financial and project progress reporting.
- Maintained open communication with AAFC Program Officer.
- Ensured completion of all Program Objectives as outlined in Activity Work Plans.

2. MACHINERY INJURY: LOW COST ROLLOVER PROTECTIVE STRUCTURES (ROPS) INTERVENTION PILOT PROJECT
- Tractor rollovers are one of the leading causes of agricultural deaths in Canada.
- ROPS have be proven to greatly reduce the risk of serious injury and death in the event of a tractor rollover, but cost remains an impediment to successful uptake.
- Pilot project developed and tested an innovative ROPS designed to be built and installed by farmers for an affordable price.
- Partnership between Prairie Agricultural Machinery Institute (PAMI) in Humboldt, SK; Injury Prevention Centre at the University of Alberta; and SafetyNet at Memorial University, St. John's, NL.

3. ANIMAL HOUSING ENVIRONMENTS PROJECTS

A. Air Quality in Canadian Pig Buildings: Reduction of Airborne Dust, Gas and Human Pathogens in Buildings and their Environmental Dispersion
- Swine barns emit airborne contaminants that can affect the health of workers, livestock and rural communities.
- First part of the project examined the exposure risk to different pathogens and antibiotic-resistant bacteria to swine workers.
- Second part of the project involved testing three airborne contaminant reduction technologies and determining the most effective combination of strategies to decrease exposure risk.
- Partnership between Institut de recherche et de développement en agroenvironment (IRDA) in Québec and Centre de recherché de l'Institut universitaire de cardiologie et de pneumologie de Québec (CRIUCPQ) at the Université Laval.

B. Reducing Pathogen Distribution from Animal Transportation
- Growing size of swine farms in Canada has resulted in more frequent livestock transport and increased risk of airborne disease transmission.
- Addressed the need to develop an enclosed livestock trailer to prevent the spread of airborne diseases which positively influences the health of swine workers and livestock by enhancing biosecurity.
- Project developed and tested an enclosed trailer design that filtered incoming and outgoing air to ensure the removal of airborne pathogens.
- Collaboration with Prairie Swine Centre (PSC), the Canadian Centre for Health and Safety in Agriculture (CCHSA) and the University of Saskatchewan College of Engineering.

4. KNOWLEDGE AND TECHNOLOGY TRANSFER (KTT) FOR ACTIVITIES 2 AND 3
- Success of applied research is strongly dependent on KTT to ensure uptake of output and information by end users.
- Developed and disseminated KTT bulletins, newsletters and videos which focused on informing farm and rural communities about the AgriSafety Program projects and increase uptake.

COMPLETING THE MOSAIC

The Canadian AgriSafety Applied Research Program and the Canadian Agricultural Safety Association (CASA) are complimentary and mutually supportive. Together their combined effort is a well-rounded output that strives to improve health and safety outcomes in agriculture through applied research. The Canadian AgriSafety Program provides the research and innovation component of enhancing health and safety in agriculture, while CASA utilizes knowledge translation and prevention programs to promote the uptake of research to practice.

Figure 1: How the Canadian AgriSafety Program fits in to the agricultural health and safety puzzle in Canada

Applied Research

Applied research is an essential part of completing the puzzle of improved health and safety outcomes in Canadian agriculture. Applied research develops practical solutions to current problems in society. There is a need for applied research in agricultural health and safety to address the gap in development of effective outcomes to reduce the rates of injury of death that remain unacceptably high.

KNOWLEDGE TRANSFER

Knowledge transfer is an essential piece of the research puzzle that brings together knowledge, innovation and products from applied research. Agriculture presents a unique challenge for knowledge transfer (KT) efforts with such a great diversity of industry organizations, producers and policy makers. To move agricultural safety practices and applications forward it is essential for transfer of this knowledge from research into practice in order to develop new processes and ways of thinking. There is an existing gap in research-to-practice knowledge transmission that knowledge transfer efforts will aid in bridging in Canadian agricultural health and safety.

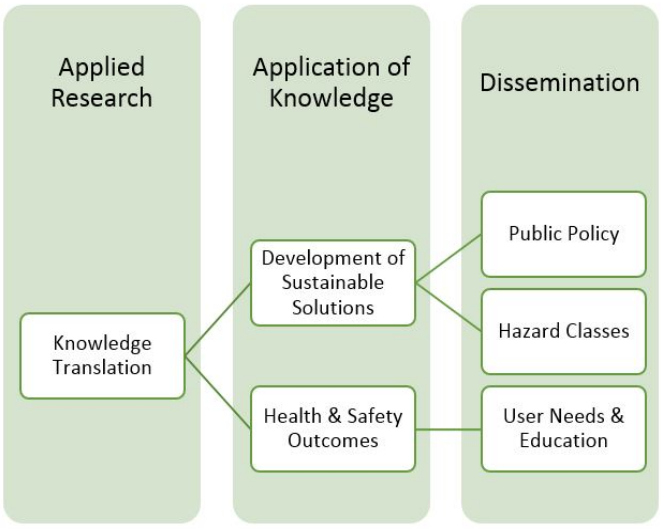

Figure 2: Knowledge transfer path

The process of KT begins with asking a relevant research question that leads to the development of improved health and safety in Canadian agriculture. The end results of KT focus on actionable tasks that contribute to practical solutions that positively impact health and safety in agriculture.

NATIONAL CONSULTATION PROCESS LEADING TO THE SIX STEPS TO SAFETY REPORT

Table 1: Development of the *Six Steps to Safety* Report

2012	Stakeholders Conference	Canadian AgriSafety Applied Research Summit (see Appendix 2 for participants)
2014	National Program 2014-2018	Canadian AgriSafety Applied Research Program: A Program of Research and Development
2015	Hierarchy Control	Discovery of three-fold reduction in farm injuries
2016	National Consultation June	National Summit on the Control of Agricultural Injuries and Death in Canada (see Appendix 1 for Scientific Panel)
2016	Workplace Safety Meeting September	Meeting in Toronto, Ontario – Workplace Safety Prevention Services

OBJECTIVES OF THE NATIONAL CONSULTATION PROCESS

1. To review and refine the topic areas for applied research and development in safety and health in Canadian agriculture.
2. Identify research priorities of each topic area aimed at defining an applied research agenda for Canada in accordance with the Hierarchy of Control.
3. Inform provincial research and prevention action planning for provinces and organizations across Canada.
4. Strengthen collaboration between researchers, agriculture sector, safety delivery agencies and policy leaders across the country.

TOPIC AREAS TO BUILD A PLAN FOR ACTION

Building on output of the National Consultation process, Agrivita and its partner organizations CCHSA and CREOD, worked with stakeholders from across Canada to develop a plan of action.

Seeking a transformative approach to elimination of farm injuries in Canada, stakeholders identified thirteen topic areas each with priorities for research based on the Hierarchy of Control: (1) Machinery and Equipment Exposures; (2) Ergonomics and Musculoskeletal Health Exposures; (3) Fertilizer and Pesticide Exposures; (4) Particulate and Dust Exposures; (5) Noise Exposures; (6) Vibration Exposures; (7) Buildings and Confined Spaces; (8) Viruses, Molecular and Disease Exposure; (9) Production Systems and Animal Handling; (10) Weather and Environment; (11) Children; (12) Older Workers; (13) Seasonal Migrant Workers.

The goal is to create the *Canadian AgriSafety Applied Science Program: Today's Innovation to Tomorrow's Prevention.*

THE HIERARCHY OF CONTROL: BASIS OF CONSULTATION AND PLANNING

The Hierarchy of Control is a highly effective, proven, preventative practice in industry that includes corrective measures to control hazards by reducing or eliminating the exposure. The consultation process and national research planning described in this report are based on utilizing the Hierarchy of Control as a means of introducing solid scientific principles into agricultural injury research and prevention. The *Six Steps to Safety* is the direct application of the Hierarchy of Control as a framework to agricultural hazard reduction and elimination in Canada.

Results of critical research from the Canadian Centre for Health and Safety in Agriculture and Queen's University has shown *farm injury rates are strikingly reduced when producers use up to four steps of the Hierarchy of Control*, decreasing three-fold from 10% per year down to 3% per year[1].

The Hierarchy of Control consists of six steps:

Step 1. Hazard identification
Recognizing hazards in the work place is the first step in planning control of the risk of injuries or illness.

Step 2. Risk assessment
Determining the risk involved in each hazard is necessary in order to evaluate the elements that require controlling or managing.

Step 3. Hazard elimination
Removing the hazard is the best means to reduce risks but may not always be possible.

Step 4. Engineering controls
Engineering controls reduce or eliminate the hazard by initial design specifications, or by applying methods of substitution, isolation, enclosure or ventilation.

Step 5. Procedural controls
Procedural controls may reduce employee exposures by such practices as scheduling reduced work times in contaminant areas and employee training regarding hazard recognition and work practice.

Step 6. Personal protective equipment
Personal protective equipment such as masks, boots, hats, glasses and hearing protection provides a buffer between the worker and the work environment.
(Fundamentals of Industrial Hygiene, NSC, 1996)

The recommendations of this report are founded in the Hierarchy of Control and inform a comprehensive plan for the elimination of farm injury and death.

[1] Dosman J, Hagel L, King N, Koehncke N, Kirychuk S, Trask C, Neudorf J, Day L, Voaklander D, Pickett W. The hierarchy of control in the epidemic of farm injury. *J Agromed*. 2015; 20:360-9.

TOPIC AREAS FOR APPLIED RESEARCH AND DEVELOPMENT

TOPIC 1. Machinery and Equipment Exposures

Most common cause of fatal and serious injuries on Canadian farms.

- Machines and equipment account for 75% and 45% of farm injuries respectively.
- Tractors, combines, augers, and motor vehicles cause most injuries
- Primary mechanisms of injury are roll-overs, run-overs, entanglement and falls.
- Traumatic injuries include crush injuries, fractures, amputations, cuts, burns and entanglements.
- Traumatic injuries occur during both operation and maintenance activities.
- Many farm machines are older with sub-standard safety designs and guarding.
- Research on applied engineering interventions on farm machinery is a priority.
- Novel procedural systems are required.

Experts: Jim Wassermann, Prairie Agricultural Machinery Institute, Humboldt SK; Louise Hagel, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Julie Sorenson, Northeast Center for Occupational Health and Safety in Agriculture, Forestry and Fishing, Copperstown NY.

Priorities	Rationale	Hierarchy of Control
1. Develop machinery engineering safety resources	Producers lack engineering safety resources	Risk Assessment Procedural Controls
2. Investigate mechanisms to facilitate producer input on machine safety	Producer concerns and ideas are a valuable conduit for improved design and implementation	Hazard Identification Engineering Controls Procedural Controls
3. Enhance all-terrain vehicle (ATV) safety	ATVs represent increasing concern and are major cause of severe injury and death	Risk Assessment Engineering Controls Procedural Controls
4. Design and develop safety equipment for older machinery	Older farm equipment is in use on many farms and lacks necessary safety equipment	Hazard Identification Risk Assessment Engineering Controls
5. Improve machine mounting access and site maintenance access	Mounting and maintenance present major injury risks	Engineering Controls
6. Create training programs on safe operation of farm machinery	Educate workers on operation of farm equipment given its size, complexity and potential for danger	Procedural Controls

References

Pickett W, Hagel L, Dosman, J. Safety Features on agricultural machines and farm structures in Saskatchewan. *J Agromed.* 2012;17:421-4. Rautainen, et al. Certified safe farms: identifying and removing hazards on the farm. *J Ag Safety and Health*. 2010;16:75-86. Dosman J, Hagel L, King N, Koehncke N, Kirychuk S, Trask C, et al. The hierarchy of control in the epidemic of farm injury. *J Agromed.* 2015;20:360-9.

TOPIC 2. Ergonomics and Musculoskeletal Health Exposures

90% of producers will have a musculoskeletal injury in their

- Chronic conditions include low back pain, carpal tunnel syndrome and shoulder tendinitis.
- Result of cumulative or repeated exposure to sustained forces, manual handling, awkward postures, long hours, fatigue and whole body vibration.
- Effects include pain, work disability, health care costs, and decreased productivity and income.
- Contributing factors include small operations with few health and safety resources, long hours and challenges in accessing musculoskeletal care.
- Acceptance among producers that chronic musculoskeletal pain is inevitable
- Development of engineering controls in parallel with guidelines such as the ILO are required.
- Development of procedural controls for prevention of musculoskeletal disorders in agriculture is a priority.

Experts: Catherine Trask and Brenna Bath, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Priorities	Rationale	Hierarchy of Control
1. Develop a database of musculoskeletal risks in principle production operations	Major causes of work time loss and compensation in grains, cattle, dairy, swine, poultry, horticulture and orchard industries	Hazard Identification Risk Assessment
2. Develop a program to provide access to timely, appropriate musculoskeletal care	Services for musculoskeletal injury not readily available	Procedural Controls Personal Protective Equip
3. Develop machinery that accommodates different postures especially combines	Prolonged exposure to static and non-ergonomic body positions results in fatigue and musculoskeletal injury	Engineering Controls Procedural Controls
4. Develop, test and evaluate training programs aimed at prevention of musculoskeletal injuries	Common practices and situations lead to musculoskeletal injuries among employees	Procedural Controls
5. Devise practical products and procedures for prevention of repetitive strain injuries	Repetitive strain injuries are a major cause of disability	Engineering Controls Procedural Controls Personal Protective Equip
6. Ergonomics knowledge translation program tailored to agriculture	Lack of online resources, videos, seminars and information specific to agricultural operations	Procedural Controls

References

Osborne, et al. Prevalence of musculoskeletal disorders among farmers: a systematic review. *Am J Ind Med*. 2011;55:143-58. Kirkhorn, et al. Ergonomic risks and musculoskeletal disorders in production agriculture: recommendations for effective research to practice. *J Agromed*. 2010;15:281-99.

TOPIC 3. Fertilizer and Pesticide Exposures

Safe use of fertilizers and chemicals is important for agricultural workers and surrounding populations.

- Exposure by contact with pesticides and fertilizers through mixing, application, contaminated clothing and equipment, and entering areas where products have been applied.
- Major routes of exposure include dermal contact, inhalation and ingestion.
- Fertilizers include livestock/ poultry fecal material, urban sewage sludge, synthetic fertilizers and various "organic" substances.
- Health outcomes include acute and chronic toxicity, reproductive and endocrine effects, respiratory symptoms, cancer, neurodevelopmental and immune effects.
- Environmental effects include potentially resistant microorganisms and impacts on ground water run-off.
- Continued development of procedural controls for safe handling of products is necessary.
- Potential for further development of engineering controls and personal protective equipment.

Experts: Paul Gunderson, Dakota Precision Agriculture Center, North Dakota; Manisha Pahwa, Occupational Cancer Research Centre, Toronto ON; Shelley A. Harris, Dalla Lana School of Public Health, Toronto ON; Paul A. Demers, Occupational Cancer Research Centre, Toronto ON.

Priorities	Rationale	Hierarchy of Control
1. Evaluation of standard operating procedures for routine use of urea and ammonia in agriculture	Standard operating procedures may not be relevant to various applications in agriculture	Risk Assessment Procedural Controls
2. Investigate options for ammonia handling and field application	Positive cab air pressure technologies and worker protocols to decrease exposure	Engineering Controls Procedural Controls
3. Availability and implementation of training and education protocols	Exposed workers may lack knowledge and training for safe use	Procedural Controls
4. Hazard assessment training for producers, employees and farm families	Producers, employees and farm families need to be equipped to assess exposures in the agricultural setting	Hazard Identification Risk Assessment
5. Examine chemical exposures to farm families and bystanders and identify means to control exposures	Farm families and bystanders require protection from exposures	Hazard Identification Risk Assessment Procedural Controls

References

Weinberg JL, Bunin LJ, Das R. Application of the industrial hygiene hierarchy of controls to priorities and promote safer methods of pest control: A case study. *Public Health Reports*. 2009:124 (Suppl. 1):53-62.

TOPIC 4. Particulate and Dust Exposures

Inhaled dust particles cause severe breathing problems.

- Exposures occur through planting, harvesting, cleaning, processing, transporting, livestock production, swine buildings, poultry houses and dairy barns.
- Crop dust components include straw, husks, insects, molds, viruses, bacteria, fungi, endotoxins.
- Animal dusts include feed and bedding materials, fecal matter, viruses, bacteria, endotoxins, molds, mycotoxins, animal hair and feathers.
- Effects on workers' lungs may be short-term such as organic dust toxic syndrome, or long-term such as chronic obstructive pulmonary disease, asthma, and farmer's lung.
- Agricultural workers have lower levels of lung function when compared to non-exposed.
- Determine safe levels of exposure through hazard identification and risk assessment
- Continued development of strategies for reducing worker and public exposures through engineering controls, procedural controls and personal protective equipment.

Experts: Shelley Kirychuk, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Matthieu Girard, Institut de recherché et de développement en agroenvironnement, Québec QB; Bernardo Predicala, Prairie Swine Centre, Saskatoon SK.

Priorities	Rationale	Hierarchy of Control
1. Establish threshold exposure guidelines in agricultural buildings	Maximum permissible exposure levels have not been established for various production operations	Hazard Identification Risk Assessment
2. Assess adequacy of ventilation systems in adapted swine facilities	Adaptations to meet new requirements do not consider ventilation systems	Hazard Identification
3. Develop strategies to reduce dust levels in agricultural buildings	Limit the impacts of various hazards caused by dusts	Engineering Controls
4. Investigate the effects of fugitive emissions following manure spreading	Lack of knowledge on risks that fugitive emissions pose to the health of workers and rural public	Hazard Identification Risk Assessment
5. Investigate practicality and effectiveness of personal protective equipment to reduce exposure	Not all existing personal protective equipment is user-friendly, task appropriate and affordable	Personal Protective Equip
6. Develop methods aimed at the protection of the general population from emissions from farm operations	Animals are potential reservoirs of human pathogens and sources of antibiotic resistance	Engineering Controls

References

Bonlokke J, Cormier Y, Sigsaard T. Agricultural environment: farming and food industry. In *Occupational and Environmental Lung Disease*. S. Tarlo, P. Culliman, B. Nemery eds. 161-76; Wiley-Blackwell; Hoboken NJ, 2010. *Safety and Health in Agriculture. ILO code of practice*. International Labour Office; Geneva, 2011. Kirychuk SP, Senthilselvan A, Dosman JA, Hurst TS. Predictors of longitudinal changes in pulmonary function among swine confinement workers. *Can Respir J*. 1998;5:472-8.

TOPIC 5. Noise Exposures

Noise from agricultural exposures causes long-term hearing loss.

- High noise exposures include agricultural equipment such as tractors, combines, augers, grain dryers, workshop-related equipment and activities, animal production, chain saws and tools.
- Noise-induced hearing loss has been found in 50% of grain and animal producers.
- Understanding of barriers to use of personal protective equipment is needed.
- Procedural controls aimed at noise exposures in specific agricultural operations are needed.
- There is a need for continued development of new technology and improved compliance with some prevention strategies required.

Experts: Niels Koehncke, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Linn Holness, St. Michael's Hospital, University of Toronto, ON.

Priorities	Rationale	Hierarchy of Control
1. Develop audiometric testing programs for producers and workers	Agriculture lacks programs of regular audiometric testing to monitor changes in hearing tests	Risk Assessment Procedural Controls
2. Develop mobile device application to measure exposures to noise	Personal dosimeters to monitor noise level exposures are necessary	Risk Assessment Engineering Controls
3. Determine decibel levels in agricultural facilities, machines and operations	Noise levels in many operations are not known	Hazard Identification Risk Assessment
4. Develop personal hearing protection that are geared toward exposures in agricultural environments	Need to address comfort and usability, and improve communication while using PPE	Personal Protective Equip
5. Educational programs and resources	Increase awareness and prevention	Procedural Controls
6. Develop engineering improvements for noise reduction	Many older machines and equipment with high noise levels remain in use	Engineering Controls

References

Humann MJ, et al. Task-based noise exposures for farmers involved in grain production. *J Agric Saf Health*. 2013;19:101-13. Voaklander DC, et al. Hearing screening program impact on noise reduction strategies. *J Agric Saf Health*. 2009;15:354-63. Lupescu C, et al. Hearing conservation program for farm families: an evaluation. *J Agric Saf Health.* 2000;5:329-37.

TOPIC 6. Vibration Exposures

Whole body vibration is a pervasive and often unrecognized cause of acute and chronic conditions.

- Whole body vibrations (WBV) are oscillatory motions that are transmitted from a mechanical structure to the body through a point of contact.
- Information on WBV exposure in agriculture is very limited.
- Exposure to machinery and work induced low frequency WBV is highly prevalent in agriculture.
- WBV is linked to disturbances in position sense, balance, visual performance, and reductions in vigilance and mental processing.
- Short-term effects of WBV are a contributing factor to fatal and non-fatal injury, including equipment and machine related injuries, falls and vehicle crashes.
- WBV is a risk factor for chronic disorders including low back pain, peripheral nervous system dysfunction, prostate disorders and gastrointestinal problems.
- Regulatory guidelines are needed to protect workers from the effects of WBV.
- Hazard identification and procedural controls are necessary to address WBV in agriculture.

Experts: Stephan Milosavljevic, School of Physical Therapy, University of Saskatchewan, Saskatoon SK; Marcus Yang, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Priorities	Rationale	Hierarchy of Control
1. Establish inventory of vibration exposures in principal agricultural tasks	Vibration exposures are not well documented in agriculture	Hazard Identification Risk Assessment
2. Develop and evaluate educational programs on WBV and human health	Lack of awareness results in unrecognized exposures and effects	Hazard Identification Procedural Controls
3. Quantify vibration exposures aimed at developing Canadian Standards Association approved standards for safe exposure limits in agriculture	Need standards for vibration exposures in agriculture to protect workers and producers	Hazard Identification Risk Assessment Procedural Controls
4. Identify and assess engineering solutions to minimize vibration exposure to operators	Sources of vibration can be controlled by reduction in exposure time or alteration in design	Hazard Elimination Engineering Controls
5. Develop and test a mobile device application to monitor and measure whole body exposure	Need for a readily available means of assessing vibration exposures	Risk Assessment Engineering Controls
6. Evaluate hand tools for segmental vibration and engineering solutions	Hand tool usage is an unrecognized source of vibration injury	Risk Assessment Engineering Controls

References

Milosavljevic S, Bagheri N, Vasiljev RM, McBride DI, Rehn B. Does daily exposure to whole-body vibration and mechanical shock relate to prevalence of low back and neck pain in rural workforce? *Ann Occup Hyg*. 2012;56:10-17. Solecki L. Assessment of annual exposure of private farmers to whole body mechanical vibration on selected family farms of plant production profile. *Ann Agric Environ Med*. 2010;17:243-50.

TOPIC 7. Buildings and Confined Spaces

Confined spaces in agriculture pose a risk of death or permanent injury due to asphyxiation or poisoning.

- Confined spaces in agriculture pose special challenges for safety as they are widespread, diverse, and necessary to operations, but the seriousness of risks is often unrecognized.
- Confined spaces in agriculture come in many forms including manure pits and transport systems; grain bins, trucks and silos; milk, fermentation and storage tanks; well cisterns, mobile equipment, and mushroom growing enclosures.
- Producers and workers may not recognize confined spaces and the hazards they present.
- When entering a confined space or other inadequately ventilated spaces, a worker may be overcome by gases or dusts which can cause permanent lung disease or death.
- Fatalities resulting from confined space entries are due to asphyxiation or poisoning by exposure to high concentrations of hydrogen sulfide, methane, nitrogen dioxide and carbon dioxide, or suffocation from flowing materials.
- Design and use of agricultural installations must employ engineering controls and procedural controls to ensure worker safety.
- Educating agricultural workers on hazard identification and risk assessment is critical.

Experts: Wendy Bennet, AgSafe, Langley BC; Glen Blahey, Canadian Agriculture Safety Association, Winnipeg MB

Priorities	Rationale	Hierarchy of Control
1. Develop a tracking system for fatalities from confined spaces in agriculture in Canada	Anecdotal evidence suggests confined spaces are a major cause of agricultural fatality in Canada but rates are unknown	Hazard Identification Risk Assessment
2. Develop protocols for confined spaces in agriculture based on practices in other industries.	Confined spaces in agriculture require tailored procedures and policies to ensure worker safety	Risk Assessment Procedural Controls
3. Develop engineering and procedural protocols for agriculture to mitigate risks from hydrogen sulfide exposure	Hydrogen sulfide gas is acutely toxic and potentially lethal substance that is a prevalent risk in agricultural installations	Engineering Controls Procedural Controls
4. Design and test engineering and procedural controls to mitigate grain bin and truck risks	Suffocation deaths and injuries in grain bins and trucks are a major issue	Hazard Elimination Engineering Controls Procedural Controls
5. Develop targeted education programs and resources	Equip producers and workers with safe operating knowledge and procedures	Risk Assessment Procedural Controls

References

McManus N. Safety and Health in Confined Spaces. 1999; Lewis Publishers: Boca Raton, FL. Alberta Labour. Occupational Health and Safety Code 2009 Explanation Guide: Part 5 – Confined Spaces http://work.alberta.ca/documents/WHS-LEG_ohsc_p05.pdf

TOPIC 8. Viruses, Molecular and Disease Exposures

Infectious diseases are a major threat to human and animal health.

- Zoonotic infections are a concern for water, air, and food quality in rural communities.
- Zoonotic infections can cross the species barrier between humans and animals. The H1N1 outbreak of 2011 is an example of animal to human transmission.
- Many diseases are zoonotic, and the trend to new emergent zoonotic diseases will continue.
- Agricultural workers are at risk of infectious diseases by exposure to aerosols, body fluids, contaminated water, food and animal byproducts.
- Biosecurity procedures, reporting measures, and use of personal protective equipment are important in in place to minimize transmissions.
- As there continue to be outbreaks, innovative practice and technology are needed to further minimize the transmission of disease.
- Engineering controls, procedural controls, and public policy initiatives are necessary.

Experts: Volker Gerdts, Vaccine and Infectious Diseases Organization (VIDO), Saskatoon SK; Baljit Singh, Veterinary Biomedical Sciences, University of Saskatchewan, Saskatoon SK; David Schneberger, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Priorities	Rationale	Hierarchy of Control
1. Establish a monitoring program for zoonotic diseases	New and emerging diseases in humans are often zoonotic	Hazard Identification Risk Assessment
2. Develop enhanced biosecurity programs for animal production facilities and transportation	Current biosecurity measures have gaps which put workers and the public at risk of exposure	Engineering Controls Procedural Controls
3. Develop means of protecting immune systems of workers and livestock in production facilities	Worker productivity and animal health are negatively impacted by exposures, affecting economic returns	Hazard Elimination Engineering Controls Procedural Controls
4. Development of practical disease prevention strategies through vaccine development, improved testing/surveillance, and policy	Zoonotic transmissions are major threats to the agricultural industry in Canada with implications for workers, the public, and animal production	Risk Assessment Engineering Controls Procedural Controls
5. Develop tracking system for zoonotic diseases with an emphasis on transmission from wildlife	Increased contact with wildlife impacts emerging diseases in humans and domestic animals	Hazard Identification Risk Assessment
6. Develop systems for monitoring and improving water quality for people and animals	Community water supplies may be impacted by intensive agricultural production with effects on health	Engineering Controls Procedural Controls

References

Coker et al. Towards a conceptual framework to support one-health research for policy on emerging zoonoses. *Lancet Infect Dis.* 2011;11:326-31. King et al. Epidemiology. Infectious diseases: preparing for the future. *Science*. 2006;313:1392-3.

TOPIC 9. Production Systems and Animal Handling

Production systems and handling large animals represent major risks of injury and illness.

- Raising animals doubles the risk of injury as compared to crop farming.
- Safe work with animals requires proper facilities, skills-training and personal protective equipment for feeding, moving, treating and grooming animals.
- Crushing injuries to feet, hands, legs, arms, head and body are common, especially in facilities such as small pens, chutes, farrowing crates and gestation stalls: these injuries may be severe or fatal.
- Dusts (including allergens, endotoxin and microbial products) may negatively affect respiratory systems; noise is a major hazard in animal confinement facilities.
- Repetitive strain injuries may result from repeated tasks such as vaccinations and ear tagging.
- Workers are at risk of zoonotic infections such as Q fever and fatal Streptococcal septicemia.
- Death may result from toxic gas in confined spaces used for feed or manure storage.
- With such a wide variety of potential hazards, a comprehensive occupational hygiene approach is needed to mitigate risks and protect workers from injuries and diseases.

Experts: Lori Lockinger, CCHSA; Chris Clarke, University of Saskatchewan; Risto Rautiainen, University of Nebraska; Temple Grandin, Colorado State University.

Priorities	Rationale	Hierarchy of Control
1. Devise protocols to reduce the risk of zoonoses/animal diseases transmission to animal handlers	Need protocols to protect the large numbers of workers in intensive production facilities from zoonoses	Risk Assessment Procedural Controls
2. Develop better equipment and restraints for the movement and transportation of animals	Severe injuries often occur to workers in the movement and transport of animals	Engineering Controls
3. Devise modules for training in animal handling for various facilities and types of livestock	Many farm injuries in Canada are from handling large animals; lack of worker training may be a factor	Procedural Controls
4. Establish a reporting system to track injuries caused by handling livestock	Data on frequency and type of injuries will assist in prevention strategies	Risk Assessment Hazard Identification
5. Devise means to reduce repetitive strain injuries in intensive production facilities	Ergonomic injuries are of significant concern in the animal production industry	Engineering Controls Procedural Controls

References

Langley RL, Morrow WEM. Livestock handling – Minimizing worker injuries. *J Agromed*. 2010;15:226-35. Brison RJ, Pickett CWL. Non-fatal farm injuries on 117 Eastern Ontario beef and dairy farms: a one year study. *Am J Ind Med*. 1992;21:623-36.

TOPIC 10. Weather and Environment

Weather and the environment are often unrecognized causes of injury.

- Workers are exposed to stress through exposure to ambient air temperature, humidity, wind, dust, precipitation and solar radiation dehydration and frost bite.
- Effects on human health include heat stroke, heat exhaustion, syncope, heat cramps, rash, dehydration, frost bite, dizziness, headaches, loss of coordination, muscle cramps, cold injury.
- UV exposure brings increased risk of skin burn injury, skin cancer, cataracts and skin lesions.
- In-field or on premise clinical intervention may be necessary.
- Effective prevention programs must include risk assessment and procedural controls; as well as elimination of the hazard and engineering controls where practical.
- Solutions such as substitution of machine performance for manual human performance, provision of task shade or wind breaks, task reorganization, worker education and training.
- Personal protective equipment such as hats, weather appropriate clothing, and sunscreen are essential.

Experts: Ewa Dabrowska, Memorial University, St. John's NFLD; Barb Neis, SafetyNet, Memorial University, St.John's NFLD.

Priorities	Rationale	Hierarchy of Control
1. Encourage work habits that take into consideration weather conditions and the environment	Producers, farm workers and family members may be affected by heat stroke or hypothermia	Procedural Controls
2. Develop leading indicators of climate-potentiated health effects	Heat stress, respiratory and cardiovascular disease, cancer, injuries and allergies/ asthma may all occur	Hazard Identification Risk Assessment
3. Identify workers at enhanced risk.	Temporary and older workers may be at enhanced risk	Hazard Identification Risk Assessment
4. Develop adaptable risk assessment processes	Different exposures for types of farm operations and geographical locations	Risk Assessment Procedural Controls
5. Develop training manuals for agriculture – modify from other industries	Administrative controls can be effective if appropriately designed and evaluated	Procedural Controls

References

International Labour Office (2011). Safety and Health in Agriculture. ILO Code of Practice. Publication of the International Labour Office, Geneva Switzerland. Hamilton-Webb A, Manning L, Naylor R, Conway J. The relationship between risk experience and risk response: a study of farmers and climate change. *J of Risk Res*. 2016;1-15.

TOPIC 11. Children

Children depend on adults to provide safe homes and play spaces.

- Children and youth on Canadian farms have high risks for disabling and fatal physical injury.
- Complex challenge for parents, occupational health and safety and agricultural professionals
- Farms are places of both work and residential living.
- Benefits to raising children on farms include physical, emotional and social aspects.
- High exposures to mechanical and chemical hazards, heights, drowning hazards and animals.
- Causes of major injury or fatality to preschool-aged children on farms are asphyxiation, drowning, bystander run-overs, and injuries while riding on farm equipment.
- Causes of major injury or fatality to young workers include roll-overs, run-overs, machinery entanglement, falls and animal trauma.
- Systematic reviews indicate failure of educational approaches to mitigate childhood injury.
- Farm children are exempt from regulatory controls, and the culture does not embrace regulations.
- All steps of the Hierarchy of Control must be implemented for prevention of injuries to children on farms and not just education alone.

Experts: William Pickett, Queen's University, Kingston ON; Barbara Marlenga, Marshfield Medical Research Foundation, Marshfield WI; Louise Hagel, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Priorities	Rationale	Hierarchy of Control
1. Identify effective and acceptable means to physically separate children from hazardous areas	If children are on the work-site, physical barriers will help to minimize exposures to hazards	Engineering Controls
2. Research to establish farm family policies on safety and means of standardizing them	Farm sites and farming families vary widely - standard policies are required	Hazard Identification Risk Assessment Procedural Controls
3. Investigate impediments to and methods of keeping preschool children away from known hazards	The most effective means of preventing child injury on the farm is to remove children from the farming environment	Risk Assessment Engineering Controls
4. Studies to assess when youth are developmentally capable of handling tractors and doing mechanized work on the farm.	Need to understand developmental readiness, cognitive readiness and physical modifications necessary to safely operate machinery	Risk Assessment Engineering Controls Procedural Controls
5. Research optimal supervision for children of various ages in a hazardous home environment, and challenges to providing it.	Understanding optimal supervision and overcoming challenges can mitigate and eliminate risks for children in agricultural environments	Risk Assessment Procedural Controls

References

Marlenga, et al. Guidelines for children's work in agriculture: implications for the future. *J Agromed*. 2012; 17:140-8. Morrongiello, et al. Adult supervision and pediatric injuries in the agricultural worksite. *Accident Annal Prev*. 2008;40:1149-56.

TOPIC 12. Older Workers

Older workers are especially vulnerable to injury and death.

- In Canada, 48% of farm operators are 55 years and older.
- Fatality rates for producers in Canada are 5.6 times higher for those aged 80 years and older as compared to all producers; and 1.6 times higher for those aged 60-69 years.
- Farming requires the ability to make decisions while performing complex and repetitive tasks; and a complex array of sensorimotor skills including vision, hearing, memory, quick reflexes and vigilance;
- Deteriorating skills from aging, disability, disease and medication use increases the risk for injury.
- Many producers continue to perform farm work well beyond the typical age of retirement and are engaged in heavy physical labour.
- Older workers often put in long hours during the busy planting and harvest seasons, even if they are no longer the primary producer.
- Older farm workers are at elevated risk of death in comparison to younger counterparts.
- Injury preventions and strategies to mitigate older workers' risk have not been fully particularized.
- Solutions across the spectrum of the Hierarchy of Control should be utilized to prevent injury and fatality in older farm workers.

Expert: Don Voaklander, Injury Prevention Centre, Edmonton AB.

Priorities	Rationale	Hierarchy of Control
1. Develop and assess effectiveness of safety initiatives for older producers	Need knowledge and prevention efforts geared towards older workers	Procedural Controls
2. Track demographics of the aging population in agriculture	Need this information to fully understand patterns in this trend	Hazard Identification Risk Assessment
3. Develop, disseminate and evaluate self-tests/checklists of capability	Provide older workers tools to assess their ability to safely work on the farm	Risk Assessment Procedural Controls
4. Investigate why older workers are still working on farms	Understanding contributing factors will assist in finding solutions.	Hazard Identification Risk Assessment

References

Voaklander DC, Hagel L, Dosman J, Warsh J, Pickett W. Farm work exposures among older farmers in Saskatchewan. *Am J Ind Med*. 2010;53:706-15. Myers JR, Layne LA, Marsh SM. Injuries and fatalities to U.S. farmers and farm workers 55 years and older. *Am J Ind Med*. 2009;52:185-94.

TOPIC 13. Seasonal Migrant Workers

Seasonal migrant workers are at a high risk of injury and illness.

- Seasonal migrant workers are from Jamaica, Mexico, Guatemala, Thailand and Philippines.
- In 2015, over 53,000 international workers participated in the Seasonal Agricultural Worker Program or the Agricultural Stream of Canada's Temporary Foreign Worker Program.
- Seasonal migrant workers have unique considerations for injury and fatality exposures.
- Risks include exposure to pesticides, machinery, equipment, conveyor belts, motorized vehicles, bobcats, forklifts and tractors, musculoskeletal disorders from repetitive movements or heavy lifting, biological exposures to bee stings.
- Work is often in extreme weather conditions without proper breaks or access to potable water.
- Risks are exacerbated by language barriers and cultural differences.
- Specific solutions tailored to the unique needs of this population from all steps in the Hierarchy of Control are necessary to protect their health, safety and well-being.

Experts: Linn Holness, University of Toronto, Toronto ON; Arcadio Viveros-Guzmán, Canadian Center for Health and Safety in Agriculture, Saskatoon SK; Karen H. Bartlett, School of Population and Public Health, University of British Columbia, Vancouver BC.

Priorities	Rationale	Hierarchy of Control
1. Develop policies for safe working conditions and worker occupational health and safety education	Need to establish guidelines for safe working conditions and OHS training protocols for migrant workers	Procedural Controls
2. Investigate potential benefits of unions in protecting farm workers and employers	Need to identify the best ways to protect workers and employers via comprehensive employment contracts	Procedural Controls
3. Examine Canadian labour cooperation agreements for agriculture	Ensure agreements contribute to promoting fair relationships between stakeholders	Risk Assessment Procedural Controls
4. Develop solutions to overcome language barriers between seasonal migrant workers and employers	Improved communication leads to increased knowledge of health and safety and prevention practices	Hazard Identification Risk Assessment Procedural Controls
5. Develop a surveillance program for injuries to migrant workers in agriculture	Injuries currently go largely unreported, and access to health care may be difficult	Hazard Identification Risk Assessment Procedural Controls
6. Develop a resource library of safety materials in the main languages of migrant workers in Canada	Most safety protocols and safety materials are available only in English	Hazard Identifications Risk Assessment Procedural Controls

References

McLaughin J, Hennebry J, Haines T. Paper versus practice: Health and safety protections and realities for temporary foreign agricultural workers in Ontario. *Perspectives Interdisciplinaires Sur le Travail et la Santé*. 2014;16:1-17. Viveros-Guzmán A, Gertler M. Latino farmworkers in Saskatchewan: Language barriers and health and safety. *J Agromed*. 2015;20:341-8.

Table 1: Component Summaries of the Canadian AgriSafety Applied Science Program

Program Component	Lead Institution	Component Summary
Scientific Coordination	Agrivita Canada Inc.	Management and administration of the Canadian AgriSafety Program through implementation of quarterly financial update protocols and annual project update reports. Annual project review and recommendations by the Agrivita BOD.
Improving Animal Biosecurity and Welfare during Transport	Prairie Swine Centre Inc. University of Saskatchewan Canadian Centre for Health and Safety in Agriculture	Pathogens including viruses can be aerosolized and thus are a risk to human and animal health. Building on a current project, Activity 3 Part B (Project AIP-P158) in order to meet the changing needs of the swine industry to improve biosecurity for both workers and livestock. Plans to develop trailer design to be widely adapted and commercialized.
Development and Assessment of Emerging Green Technologies to Reduce Aerosol Risks and Hazards in Farms	University of Saskatchewan CCHSA Prairie Swine Centre Inc. CRIUCPQ – U. Laval IRDA	Reduction of particulate matter and microbes in livestock is paramount to improving livestock health and productivity and to maintaining the health of workers. Electrostatic precipitation (ESP) has the potential to be a robust and economically viable strategy to reduce particulate matter and associated microbes and odours in livestock production facilities.
Fugitive Emissions Following Manure Spreading	IRDA CCHSA PAMI CRIUCPQ – U. Laval	Manure spreading has many benefits to agricultural production, but can be a source of pollution which impacts the health of workers, livestock and rural communities. By quantifying airborne contaminants resulting from manure spreading, the health risks can be evaluated and best practices to mitigate exposure risk determined.
Developing Strategies to Minimize Health Risks in Next Generation Livestock Buildings Integrating Modern Animal Welfare Considerations	IRDA CCHSA University of Saskatchewan Prairie Swine Centre Inc.	Increasing concern over the welfare of livestock has led to changes in production barns; however, these changes have the potential to impact air quality. Evaluation of air quality in livestock barns examining the new standards for animal welfare will fill the knowledge gap on health risks of these new welfare standards and develop improvement strategies.
Technology to Improve the Health & Safety of Workers Responsible for Cleaning Livestock Transport Trailers	PAMI University of Saskatchewan CCHSA	Cleaning and disinfection of livestock transport trailers are important factors in biosecurity, but pose significant risk exposures for workers including slips and trips, infectious disease exposure and ergonomic hazards. Development and evaluation technology to reduce/eliminate health and safety risks for workers by designing a remotely operated cleaning system.
Surveillance of Zoonotic Emerging Diseases (SIZED)	University of New Brunswick Dalhousie University CCHSA National Microbiology Laboratory	Increase in the emergence of zoonotic disease prompts the need for a nationwide surveillance program of zoonotic disease. Replicating method used in Maritimes study for Lyme disease. Establish baseline in SK to determine seroprevalence estimate for range of zoonoses and complete cross-analysis between SK, NS and NB.
Take a Break from the Shake: Farm Machinery Operator Interventions	CCHSA PAMI	Whole body vibration (WBV) caused by operating farm equipment for prolonged periods causes increased risk of fall and collisions among other hazards. The development and testing of an intervention program for alternate activity breaks to mitigate the effects of WBV due to farm equipment operation would positively impact health and safety practices.

Roll Out of Low Cost Farmer-Built ROPS in a National ROPS Program	PAMI CASA	Extending from current ROPS project, Activity 2 (Project AIP-P158). Development of more ROPS blueprints, a certification system and website to distribute blueprints. Develop protocols to make this a self-sustaining long-term project.
The Saskatchewan Farm Safety Plan	CCHSA	Tailor CASA's CanadaFarmSafe Plan to Saskatchewan and incorporate the 6 Steps to Safety approach of the Hierarchy of Control to minimize injury on farms. Develop plan, test implementation, evaluate, review plan, preparation for broader distribution and implementation by farmers.
Knowledge Transfer	CCHSA	Knowledge Transfer (KT) for each project at the program level. Managed by Agrivita and contracted to CCHSA. KT activities will be coordinated for the entire program to provide a unified, consistent output to increase awareness of the program and health and safety in agriculture.

* Canadian Centre for Health and Safety in Agriculture (CCHSA); Centre de recherche de l'Institut universitaire de cardiologie et de pneumologie de Québec (CRIUCPQ) at the Université Laval; Institut de recherche et de développement en agroenvironment (IRDA); Prairie Agricultural Machinery Institute (PAMI); Canadian Agricultural Safety Association (CASA).

Table 2: How the Topics of the Canadian AgriSafety Applied Science Program Utilize the Hierarchy of Control

ACTIVITY	STEPS IN HIERARCHY OF CONTROL					
	1 Identify Hazard	2 Assess Risk	3 Eliminate Hazard	4 Engineering Controls	5 Procedural Controls	6 Personal Protection Equipment
1. Scientific Coordination	✓	✓	✓	✓	✓	✓
2. Improving Animal Transport Biosecurity & Welfare			✓	✓	✓	
3. Emerging Green Technologies to Reduce Aerosol Risks & Hazards in Farms	✓	✓		✓		
4. Fugitive Emissions Following Manure Spreading	✓	✓		✓		
5. Animal Welfare & Air Quality		✓		✓		
6. Trailer Cleaning System			✓	✓	✓	
7. Surveillance of Zoonotic Emerging Diseases	✓	✓			✓	
8. Take a Break from the Shake					✓	
9. Low-Cost ROPS Program Rollout				✓		
10. The Saskatchewan Farm Safety Plan	✓	✓	✓	✓	✓	✓

Appendix 1: International Panel of Scientific Experts

2016 National Summit on the Control of Agricultural Injuries and Death in Canada

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Appendix 2: National Summit Participants

2016 National Summit Participants

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