AGRIVITA
CANADA INC.

SIX STEPS TO SAFETY®

Sustainability & Productivity in Agriculture

Plan of the Canadian AgriSafety Applied Science Program

October 2022

| www.agrivita.ca |

EXECUTIVE SUMMARY

The purpose of the Six Steps to Safety plan of the Canadian AgriSafety Applied Science Program is to structure a coordinated comprehensive program for applied science and innovation in agricultural health and safety and its effective translation leading to sustainability and productivity in the agricultural sector Canada.

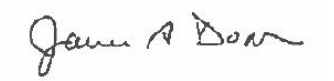
With the continued evolution of technology and practice in Canadian agriculture and given the multiplicity of sectors, existing and emerging issues, the occurrence of illness, injury and death have been resistant to change. It has been demonstrated that applied research and innovation is the essential next step to materially effect change.

The report is based on an extensive consultation among agricultural stakeholders in Canada including producers, expert panel members, private sector companies, government agencies, commodity groups, associations and individuals. Building on the foundation of existing knowledge, the report contains a blueprint for science and innovation necessary to control principle workplace health and safety issues.

Based on established occupational safety principles and the Hierarchy of Control, the report suggests applied science projects and the rationale for those projects in fifteen key Topic Areas. The Topic Areas are: (1) Farm Stress and Mental Health (2) Machinery and Equipment Exposures; (3) Ergonomics and Musculoskeletal Health Exposures; (4) Fertilizer and Pesticide Exposures; (5) Particulate and Dust Exposures; (6) Noise Exposures; (7) Vibration Exposures; (8) Buildings and Confined Spaces; (9) Viruses and Molecular Disease Exposure; (10) Production Systems and Animal Handling; (11) Weather and Environment; (12) Indigenous Agriculture; (13) Children and Adolescents; (14) Older Workers; (15) Seasonal and Migrant Workers.

Recognizing that not all of these areas can be accomplished in the short-term, the report suggests applied science and innovation in the next round of applications in 4 strategic areas. Taken together, these six areas draw on elements of all fifteen Topic Areas in the report.

We believe that the Six Steps to Safety plan for the Canadian AgriSafety Applied Science Program represents a significant step towards sustainability and productivity in Canadian agriculture.



James Dosman
President & CEO
Agrivita Canada Inc.

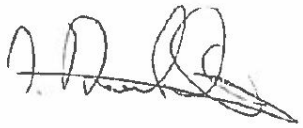


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TABLE OF CONTENTS

AGRIVITA CANADA INC. (AGRIVITA)

Agrivita is a national incorporated not-for-profit company that stimulates and supports applied health and safety research and development aimed at sustainability and productivity in Canadian agriculture. Agrivita is committed to ensuring that farmers and agricultural workers have a standard of work conditions and safety equivalent to other major industries in Canada.

PROMOTE Six Steps to Safety as a framework for research and education designed to improve safety and productivity of agriculture in Canada

LEAD development of priorities for cutting-edge applied research in agricultural health and safety in Canada

CONTRIBUTE to effective translation of knowledge and technology in health and safety for the agricultural sector

CONNECT the agricultural health and safety research community with the end-users through collaboration with stakeholders

COORDINATE and manage the Canadian AgriSafety Applied Science Program

SEEK opportunities to promote and facilitate increased investment in strategic research for agricultural health and safety

Visit us at www.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 agricultural workers.

- Scientists addressing safety and health issues critical to Canadian agriculture
- Training program aimed at developing the next generation of Canadian scientists
- *National Industrial Hygiene Laboratory*, a Canadian research and development hub
- Knowledge transfer with a mailing list of 26,000

CCHSA CCSSMA
Canadian Centre for Health and Safety in Agriculture
Centre canadien de santé et sécurité en milieu agricole

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

THE CENTRE FOR RESEARCH EXPERTISE IN OCCUPATIONAL DISEASE (CREOD)

CREOD is a collaborative program at the University of Toronto aimed at conducting research and training in occupational health and safety.

- Dedicated to improving the understanding and prevention of occupational disease
- Training program in occupational health and safety
- Working with policy-makers to develop safe and healthy workplaces

creod Centre for Research Expertise in Occupational Disease

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

THE STAKEHOLDERS

Producers, industry representatives, researchers, policymakers, program delivery professionals and private sector supporters have provided the input upon which these recommendations are based (see Appendix 1).

Introduction

This report is a plan for applied science and innovation in agricultural safety and health in Canada.

The report is based on a multi-stage national consultation aimed at a focused coordinated approach to scientific research and development for potential funding under the *Canadian Agricultural Strategic Priorities Program* (CASPP) of Agriculture and Agri-Food Canada (AAFC).

This report is a living document involving two national summits, a virtual summit, and extensive sectoral consultation with stakeholders (see Appendix 1). The process was based on balancing existing science concerning health and safety issues for farmers and agricultural workers with the need for new knowledge and innovation in priority areas (see Table 1).

It was recognized that structuring applied scientific research and innovation according to proven occupational health and safety principles through the Six Steps of the Hierarchy of Control provided the best opportunity to link human sustainability and productivity in the agricultural sector. Thus, this report is entitled *Six Steps to Safety: Sustainability and Productivity in Canadian Agriculture*.

This process resulted in the funding of three four-year projects in 2014 through the Canadian AgriSafety Applied Research Program of Agrivita Canada Inc. by the *Growing Forward 2 Industry-Led Research and Innovation* stream of Agriculture and Agri-Food Canada. Involving stakeholders from five provinces these projects were successfully completed.

Subsequently, as the Six Steps to Safety Plan continued to evolve, a further six projects were funded for four years in 2019 through the Canadian AgriSafety Applied Science Program of Agrivita Canada Inc. bu the *Agricultural Strategic Priorities Program* of Agriculture and Agri-Food Canada with matching funds from private and public sources. These projects are currently underway.

Sustainability and productivity in Canadian agriculture

The goal is to achieve sustainability and productivity in Canadian agriculture by arresting the tide of workplace injury, illness and death by a comprehensive planned approach to science and innovation through proven methods that bring outcomes directly into priority areas." - Letter of Support from Stakeholders

Letter of Support

It is a pleasure to have been involved in the process leading up to this report because we believe that the health and safety of farmers, their families, and agricultural workers is absolutely essential for the sustainability and productivity of our industry.

One of us (RO) and officials of Farm Credit Canada had the privilege of Co-Chairing two previous Summits in this development process. The planned in-person Summit for 2020 was replaced by distance consultation. During this time we have been struck by the continued maturation of the Six Steps to Safety Report and the manner in which it responds to the urgent needs of Canadian 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 workplace injury and death despite extensive educational efforts. We believe that this speaks to the need for science and innovation to support education and workplace efforts that is embodied in this report.

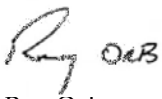
One area that has been on our radar for quite some time but has received considerable attention recently has been the area of farm stress and the delivery of applied interventions for farmers and their families. This area has been highlighted by recent reports that have importantly influenced the updated Six Steps to Safety plan. We believe that this area is a particularly important one for applied research, innovation, and action.

The Six Steps to Safety plan involves 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 to be an effective tool for reducing agricultural workplace injury and death. Consultations worked towards identifying priorities for applied science and innovation and 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.

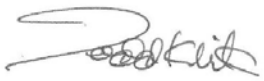
The goal is to achieve sustainability and productivity in Canadian agriculture by arresting the tide of workplace injury, illness, and death by a comprehensive planned approach to science and innovation through proven methods that bring outcomes directly into priority areas.

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

Sincerely,



Ray Orb
President
Saskatchewan Association of Rural Municipalities (SARM)



Todd Klink,
Executive Vice President & Chief Marketing Officer
Farm Credit Canada

Farm Credit Canada. 2020. *Rooted in Strength: taking care of our families and ourselves.* Available online: https//www.fcc-fac.ca/fcc/knowledge/wellness/mental-health-publication-e.pdf.Access on September 24, 2020.
Mental Health: A Priority for Our Farmers - Report of the Standing Committee on Agriculture and Agri-Food. House of Commons, AGRI, Evidence, 1st Session, 42nd Parliament, May 2019(Pat Finnigan, Chair, Standing Committee on Agriculture and Agri-Food).
Jones-Bitton, A., et al. *Stress, anxiety, depression, and resilience in Canadian farmers.* Soc Psychiatry Psychiatr Epidemiol. 2020;55(2): 229-236.

ROLE OF THE CANADIAN AGRISAFETY PROGRAM

THE ISSUE: Agriculture is one of the most dangerous industries in Canada, threatening the sustainability and productivity of the industry.

- 2,324 people killed on Canadian farms 1990 - 2012.
- 1,360 people severely injured each year.
- Hazards: farm stress, injuries and deaths, musculoskeletal, fertilizer and pesticides, particulate and dusts, noise, vibration, buildings and confined spaces, viruses and molecular diseases, weather, children and adolescents, older workers, seasonal and migrant workers, production systems and animal handling.
- Productivity: injuries $300 million/year.
- Sustainability: rates resistant to change.

THE GAP: Lack of applied research to address issues.

- Canada has education programs supported by public and private sectors.
- Education alone is insufficient to control the epidemic.
- Triad of education, engineering, and workplace management is required.
- Canada must have an organized applied research and development program for scientific innovation to discover and develop better education programs, engineering controls and workplace management.
- Hiearchy of Control provides an organized structure for AgriSafety innovation.

NATIONAL CAPABILITY: A National interdisciplinary approach is required.

- Canadian Centre for Health and Safety in Agriculture (CCHSA), University of Saskatchewan
- National Agricultural Industrial Hygiene Laboratory with central node at University of Saskatchewan
- Centre for Research and Education in Occupational Diseases (CREOD), University of Toronto
- Institut de recherche Robert-Sauve en sante et en securite (IRSST), Montreal QC
- Institut de recherche de development en agroenvironment (IRDA) Quebec City, QC
- Institut universitaire de cardiologie et de pneumologie de Quebec (IUCPQ) Laval University
- Occupational Cancer Research Centre (OCRC), University of Toronto
- School of Population and Public Health, University of British Columbia
- Injury Prevention Centre, University of Alberta
- Partnerships with Canadian universities and research centres

SUCCESS: The Canadian AgriSafety Programs: 2014 to 2018, 2019 - 2024

- Agrivita's Canadian AgriSafety Applied Research Program supported in 2014 to 2018 by AAFC's Industry-Led Research and Innovation stream of the Agri-Innovation Program of Growing Forward 2.
- Agrivita's Canadian AgriSafety Applied Science Program supported in 2019 to 2024 by AAFC's Canadian Agricultural Strategic Priorities Program

POLICY IMPLICATIONS: Sustainable, productive agriculture is attainable.

- Enhanced agricultural safety and health will improve sustainability and productivity.
- New products and patents.
- World leadership as Canada addresses critical workplace health and safety issues.
- "*It's the right thing to do*". (Quoted with permission from the late Mr. Lorne Martin, ADM, Manitoba Agriculture Food and Rural Development).

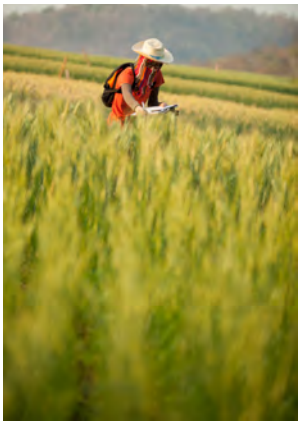
COMPLETING THE MOSAIC

Multiple stakeholders are complementary. The Canadian AgriSafety Program and knowledge transfer of the Canadian Agricultural Safety Association (CASA) and the Canadian Centre for Health and Safety in Agriculture (CCHSA) are complementary 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 and innovation. The Canadian AgriSafety Program provides the research and innovation component of enhancing health and safety in agriculture, while partners utilize knowledge translation and prevention programs to promote the uptake of research to practice. The result is enhanced sustainability and productivity in Canadian agriculture.

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

APPLIED SCIENCE

Applied science is an essential part of completing the puzzle of improved health and safety outcomes in Canadian agriculture. Applied science 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 the development of effective outcomes to reduce the rates of injury and 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 a diversity of producers, private sector business, industry organizations, delivery agencies, and policymakers. To move agricultural health and safety practices and applications forward it is essential for transfer of this knowledge from research into practice. The result is new processes, products and ways of thinking. There exists a major gap in research and innovation and effective transfer to the agricultural sector necessary to fuel substantive change.

The process of KT begins by asking relevant research questions that lead to the development of improved health and safety in Canadian agriculture. The end results of KT focus on actionable tasks that lead to practical solutions enhancing sustainability and productivity in agriculture.

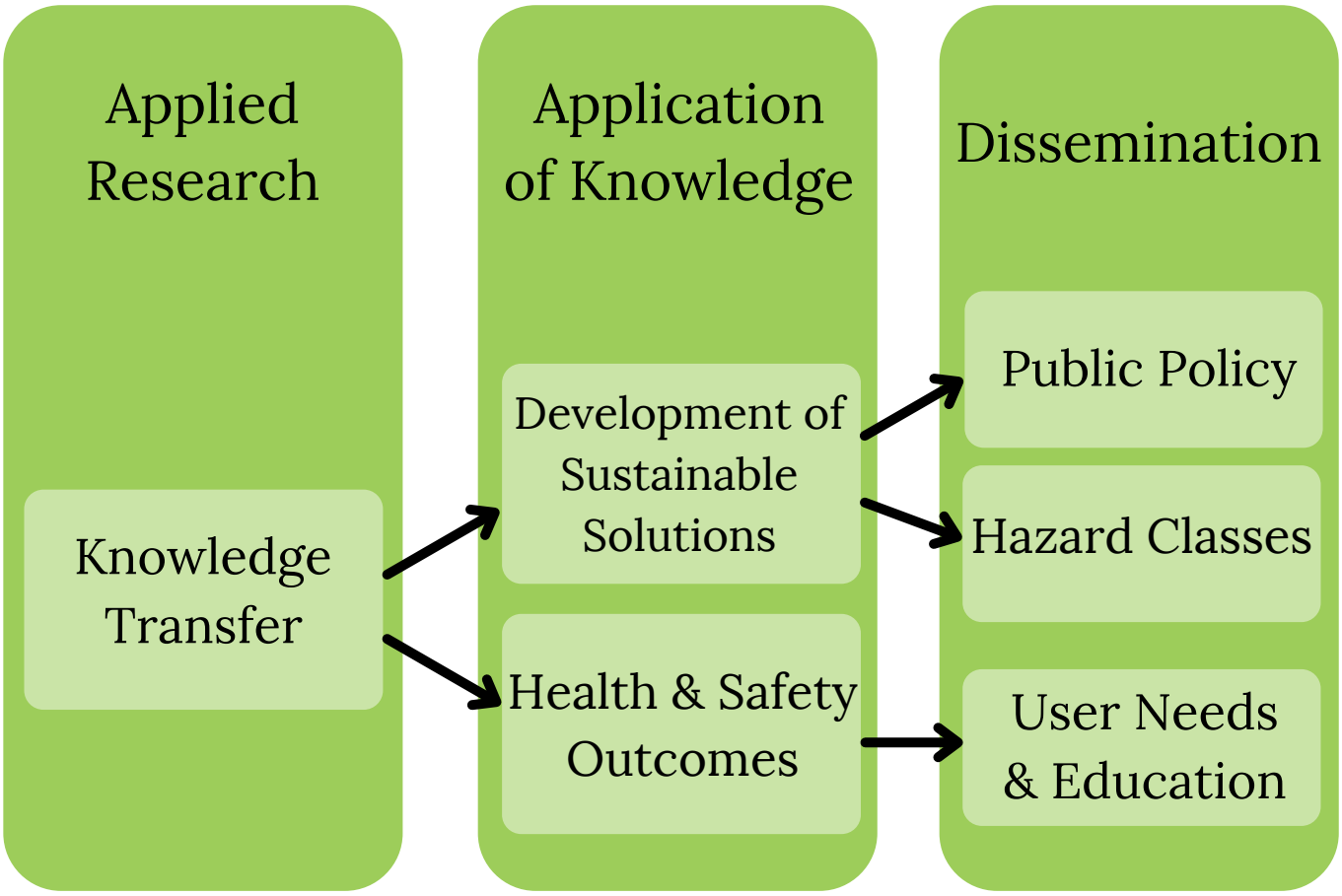


Figure 2: Knowledge transfer path

NATIONAL CONSULTATION PROCESS LEADING TO THE SIX STEPS TO SAFETY REPORT

Table 1: Development of the *Six Steps to Safety* Report: A Process of Continued Consultation

2012	Stakeholders Conference	Canadian AgriSafety Applied Research Summit
2014	National Program 2014-2018	Canadian AgriSafety Applied Research Program: A Program of Research and Development
2015	Hierarchy of Control	Research shows that farmers who adhere to Hierarchy of Control have three-fold reduction in farm injuries. Confirms approach to prevention.
2016	National Consultation June	National Summit on the Control of Agricultural Injuries and Death in Canada
2016	Workplace Safety Meeting September	Meeting in Toronto, Ontario Workplace Safety Prevention Services
2019	National Program 2019-2024	Canadian AgriSafety Applied Science Program – 6 Projects in Key Areas
2020	National Consultation	Virtual Summit Urgent and Emerging Issues

OBJECTIVES OF THE NATIONAL CONSULTATION PROCESS

1. To review and refine the topic areas for applied science and innovation in safety and health in Canadian agriculture.

2. Identify research priorities of each topic area aimed at defining an applied science and innovation 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, producers, private sector, safety and health delivery agencies and policy makers across the country.

THE HIERARCHY OF CONTROL: BASIS OF CONSULTATION & PLANNING

The Hierarchy of Control is an effective, proven, preventative practice in industry that includes recognition of and corrective measures to control hazards by eliminating or reducing 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 or Health and Safety in Agriculture (CCHSA) and Queen's University on 2,459 farmers 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.

The Hierarchy of Control consists of six steps:

Step 1. Hazard Identification
Recognizing hazards in the workplace 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 contaminated areas and employee training regarding hazard recognition and work practice.

Step 6. Personal Protective Equipment (PPE)
Personal protective equipment such as masks, boots, hats, glasses and hearing protection provides a buffer between the worker and the work environment.

The recommendations of this report are grounded in the Hierarchy of Control and inform a comprehensive plan to build safe and healthy agricultural workplaces.

DosmanJ, 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 TO BUILD A PLAN FOR ACTION

Building on the 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 the elimination of agricultural injury and health barriers in Canada, stakeholders identified fifteen topic areas each with project concepts for research based on the Hierarchy of Control: (1) Farm Stress and Mental Health; (2) Machinery and Equipment Exposures; (3) Ergonomics and Musculoskeletal Health Exposures; (4) Fertilizer and Pesticide Exposures; (5) Particulate and Dust Exposures; (6) Noise Exposures; (7) Vibration Exposures; (8) Buildings and Confined Spaces; (9) Viruses and Molecular Disease Exposures; (10) Production Systems and Animal Handling; (11) Weather and Environment; (12) Indigenous Agriculture; (13) Children and Adolescents; (14) Older Workers; (15) Seasonal and Migrant Workers.

The goal is to create the next phase of the *Canadian AgriSafety Applied Science Program.*

FOUR STREAMS FOR 2023-2028

As a result of input, the Canadian AgriSafety Applied Science Program is suggesting the following emerging and urgent issues for applied science and innovation projects.

Stream 1: Stress and Mental Health

Stream 2: Environment and Climate Change

Stream 3: Health and Safety in Underrepresented Populations

Stream 4: Control of Injury and Illness

Topic Areas for 2022 - 2026 Applied Science & Innovation

TOPIC 1. FARM STRESS & MENTAL HEALTH

| *Farm stressors: workload, weather, financial, markets, long work hours* |

- 45% of farmers surveyed have high levels of perceived stress.
- 57% meet the criteria for anxiety classification.
- 35% meet the criteria for depression classification.
- 40% feel uneasy getting help.
- Binge drinking is common.
- 56% of farmers are sleep-deprived in peak season.
- Mental health, stress and sleep deprivation as a result of chronic pain or injury.

Expert Panel: Andria Jones-Bitton, Ontario Veterinary College, University of Guelph, Guelph, ON; Niels Koehncke, Canadian Centre for Health and Safety and Agriculture, Saskatoon, SK; Punam Pahwa, Canadian Centre for Health and Safety in Agriculture, Saskatoon, SK; Chandima Karunanayake, Canadian Centre for Health and Safety in Agriculture, Saskatoon, SK; Bonnie Janzen, Department of Community Health and Epidemiology, University of Saskatchewan, Saskatoon, SK; Brianna Hagen, Ontario Veterinary College, University of Guelph, Guelph, ON; Kendra Ulmer, Canadian Centre for Health and Safety in Agriculture, Saskatoon, SK; Marilyn Baetz, Department of Psychiatry, University of Saskatchewan, Saskatoon, SK.

Applied Science Projects	Rationale	Hierarchy of Control
1. Understand nature and scope of issues among commodity groups	Estimates of mental health outcomes in Canadian farmers are lacking	Hazard Identification Risk Assessment
2. Develop models for healthy workplace management practices	Means of promoting positive mental health largely unstudied	Procedural Controls
3. Assess and refine existing evidence-informed models for use in agricultural crises	Such models have a high priority for development	Risk Assessment Procedural Controls
4. Assess effectiveness of emergency response models among commodity groups	Unknown effectiveness of models	Risk Assessment Procedural Controls
5. Develop models for positive mental health in seasonal workers	Little information available in major issue	Procedural Controls

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Jones-Bitton A, et al. Stress, anxiety, depression, and resilience in Canadian farmers. Soc Psychiatry Psychiatr Epidemiol; Mental Health: A Priority for Our Farmers - Report of the Standing Committee on Agriculture and Agri-Food. (House of Commons, AGRI, Evidence, 1st Session, 42nd Parliament, May 2019 (Pat Finnigan, Chair, Standing Committee on Agriculture and Agri-Food). Available from https://www.ourcommons.ca/ Content/Committee/421/AGRI/ Reports/RP10508975/agrirp16/agrirp16-e.pdf. Access on Sep 20, 2020; Janzen B, Karunanayake C, Rennie D, Lawson J, Dosman JA, Pahwa P. Depression and binge drinking in farm and non-farm rural adults in Saskatchewan, Canada. *Rural Remote Health*. 2020;20(1):5530.; Karunanayake CP, Pahwa P. Statistical modelling of mental distress among rural and urban seniors. Chronic Dis Can. 2009;29(3):118-127; Farm Credit Canada. 2020. Rooted in Strength: taking care of our families and ourselves. Available online: https://www.fcc-fac.ca/fcc/knowledge/wellness/mental-health-publication-e.pdf Access on September 24, 2020; The Agricultural Health and Safety Network. Daily chore: handling stress on the farm. First edition, 2000. The Agricultural Health and Safety Network , Canadian Centre for Health and Safety in Agriculture (CCHSA), University of Saskatchewan, Saskatoon. Available from https://cchsa-ccssma.usask.ca/aghealth/documents/resources-by-theme/Daily%20Chore%20Stress%20Res.pdf Accessed on September 10, 2020.
https://www.medicalnewstoday.com/articles/314493#The-largest-back-pain-mental-health-study-to-date

TOPIC 2. MACHINERY & 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.

Expert Panel: James Wassermann, James Wassermann Consulting Services, Muenster SK; William Pickett, Brock University, St. Catherines, ON; Don Voaklander, University of Alberta, Edmonton, AB; Risto Rautiainen, University of Nebraska; 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, Cooperstown NY.

Applied Science Projects	Rationale	Hierarchy of Control
1. Determine relationships between farm stress/sleep loss and farm injuries and develop sector-specific prevention modules	Farm stress and sleep loss may be primary factors resulting in farm injury.	Risk Assessment Elimination of Hazard Procedural Controls Engineering Controls
2. Develop machinery engineering safety resources	Producers lack engineering safety resources	Risk Assessment Procedural Controls
3. 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
4. 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
5. 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
6. Improve machine mounting access and site maintenance access	Mounting and maintenance present major injury risks	Engineering Controls
7. Develop dissemination and distribution for solutions developed in projects 1-5	Time, money, safety equipment supplies and distribution channels play a primary role in actualizing safety efforts on farms.	Procedural Controls Engineering Controls

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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 3. ERGONOMICS & MUSCULOSKELETAL HEALTH EXPOSURES

| 90% of producers will have a musculoskeletal injury in their lifetime |

- Chronic conditions include low back pain, carpal tunnel syndrome and rotator cuff injury.
- 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, social impacts 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.

Expert Panel: Stephan Milosavljevic, School of Rehabilitation Science, University of Saskatchewan, Saskatoon, SK; Wadena Burnett, University of Saskatchewan, Saskatoon, SK; Catherine Trask, Stockholm, Sweden; Brenna Bath, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; James Dickey, University of Western Ontario, London, ON; David Kingston, University of Nebraska, Omaha, Nebraska.

Applied Science Projects	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 Equipment
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 in intensive livestock production	Engineering Controls Procedural Controls Personal Protective Equipment
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 4. FERTILIZER & 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, sewage sludge and synthetic fertilizers.
- Health outcomes include acute and chronic toxicity, reproductive and endocrine effects, respiratory symptoms, neurodevelopmental and immune effects.
- Potential carcinogenicity of pesticides and other agricultural chemicals.
- Environmental effects include potentially resistant microorganisms and impacts on ground water run-off.
- Endotoxins potentiate effects of pesticides.
- Further development of procedural controls, engineering controls and personal protective equipment.

Expert Panel: Shelley Kirychuk, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; George Katselis, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; 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; Upkardeep Pandher, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Applied Science Projects	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 are needed	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
6. Measure chemical exposures to farmers and farm workers and identify means to control exposures	Potential risks and controls need to be better understood	Hazard Identification Risk Assessment Procedural Controls
7. Evaluate individual and combined effects of endotoxin and pesticides	Pesticide inhalation may induce lung inflammation enhanced by endotoxin	Risk Assessment Procedural Controls

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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.

Upkardeep Pandher, Shelley Kirychuk, David Schneberger, Brooke Thompson, Gurpreet Aulakh, RS Sethi, Baljit Singh. Synergistic lung inflammation from co-exposure to LPS and glyphosate. Status: reviewed by co-authors. Expected submission: Dec 2020

TOPIC 5. PARTICULATE & 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.

Expert Panel: Shelley Kirychuk, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Stephane Lemay, Institut de recherché et de développement en agroenvironnement, Québec QB; Stephane Godbout, Institut de recherché et de développement en agroenvironnement, Québec QB; Bernardo Predicala, Prairie Swine Centre, Saskatoon SK; Lifeng Zhang, University of Saskatchewan, Saskatoon, SK; George Katselis, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; David Schneberger, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Upkardeep Pandher, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Applied Science Projects	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 Equipment
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

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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 6. 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.

Expert Panel: Niels Koehncke, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Linn Holness, St. Michael's Hospital, University of Toronto, ON; Kannan Krishnan, IRSST, Quebec.

Applied Science Projects	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 Equipment
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 7. 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.

Expert Panel: Stephan Milosavljevic, School of Physical Therapy, University of Saskatchewan, Saskatoon SK; Niels Koehncke, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK; Kannan Krishnan, IRSST, Quebec; Anil Adisesh, St. Michael's Hospital, University of Toronto, ON; David Kingston, University of Nebraska, Omaha, Nebraska; Wadena Burnett, University of Saskatchewan, Saskatoon, SK.

Applied Science Projects	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 8. BUILDINGS & 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.

Expert Panel: Bernardo Predicala, Prairie Swine Centre, Saskatoon SK; Stephane Lemay, Institut de recherché et de développement en agroenvironnement, Québec QB; Stephane Godbout, Institut de recherché et de développement en agroenvironnement, Québec QB; Ernie Barber, University of Saskatchewan, Saskatoon, SK; Paul Gunderson, Dakota Precision Agriculture Center, North Dakota; Wendy Bennet, AgSafe, Langley BC.

Applied Science Projects	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 9. VIRUSES & MOLECULAR DISEASE EXPOSURES

| *Infectious diseases are a major threat to human and animal health* |

- COVID-19 represents a significant threat to the health of agricultural workers and to animal production in certain sectors such as mink production.
- Zoonotic infections can cross the species barrier between humans and animals. The H1N1 outbreak of 2011 and the COVID-19 outbreak are examples of animal to human transmission.
- Zoonotic infections are a concern for water, air, and food quality in rural communities.
- Seasonal and migrant farm workers appear particularly vulnerable.
- 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.
- Engineering controls, procedural controls, and public policy initiatives are necessary.

Expert Panel: Volker Gerdts, Vaccine and Infectious Diseases Organization (VIDO), Saskatoon SK; Baljit Singh, University of Calgary, Calgary, AB; Cheryl Waldner, University of Saskatchewan, Saskatoon, SK; Bruce Reeder, University of Saskatchewan, Saskatoon, SK; Anil Adisesh, St. Michael's Hospital, University of Toronto, ON; David Schneberger, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Applied Science Projects	Rationale	Hierarchy of Control
1. Establish a method of preventing infectious disease amongst seasonal workers	Current COVID-19 spread amongst workers on-farm housing demonstrates need	Hazard Identification Risk Assessment Procedural Controls
2. 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
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 accessible commodity and regional specific education materials and simplified process teach basic biosecurity for livestock operations using the ARITS algorithm Assessment, resistance, isolation, traffic control and sanitation	The ability of someone on the operation to be able to assess the biosecurity threats to people and animals is critical	Engineering Controls Procedural Controls Hazard Identification Risk Assessment

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 10. PRODUCTION SYSTEMS & 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.

Expert Panel: Chris Clarke, University of Saskatchewan, Saskatoon, SK; Risto Rautiainen, University of Nebraska; Temple Grandin, Colorado State University; Julie Sorenson, Northeast Center for Occupational Health and Safety in Agriculture, Forestry and Fishing, Cooperstown NY.

Applied Science Projects	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. Develop and pilot test program to provide cost-sharing for animal handling systems installation	Farms that have decreased hazard exposure have expanded business, providing economic benefit.	Procedural Controls Engineering 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 11. WEATHER & 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.

Expert Panel: Paul Gunderson, Dakota Precision Agriculture Center, North Dakota; Stephan Milosavljevic, School of Physical Therapy, University of Saskatchewan, Saskatoon SK; Ewa Dabrowska, Memorial University, St. John's NFLD; Barb Neis, SafetyNet, Memorial University, St.John's NFLD; Wadena Burnett, University of Saskatchewan, Saskatoon, SK.

Applied Science Projects	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 12. INDIGENOUS AGRICULTURE

| *Indigenous agriculture* |

- 3 – 4 million acres of First Nations reserve land in Saskatchewan is devoted to agriculture farmed mostly by non-Indigenous farmers.
- Health and safety in Indigenous agriculture needs to recognize unique cultural aspects.
- Little research to date is present on maximizing peoples' wellbeing in Indigenous agriculture.
- Revival of Indigenous agriculture as a form of economic development and a path towards reconnecting and integrating cultural and traditional knowledge into agricultural projects is important.

Expert Panel: Melissa Arcand, Department of Soil Sciences, University of Saskatchewan, Saskatoon, SK; Malcolm King, Member of the Mississaugas of the Credit First Nation, College of Medicine, University of Saskatchewan, Saskatoon, SK; Dale Worme, National Indigenous Agricultural Association, Saskatoon, SK; Shaun Soonias, Director, Indigenous Relations, Farm Credit Canada.

Applied Science Projects	Rationale	Hierarchy of Control
1. Identify the scope and nature of Indigenous agriculture in Canada	Detailed information is needed to fully understand the health and safety gaps specific to the agriculture sector	Hazard Identification Risk Assessment
2. Identify principal risks involved in an Indigenous agriculture context	Specific hazard identification and risk assessment is needed	Hazard Identification Risk Assessment
3. Identify and compile electronic safety resources for the grains industry with Indigenous lens	There is currently insufficient information and resources available in this area	Risk Assessment Procedural Controls
4. Identify the economic and wellness benefits of Indigenous agriculture	Detailed information is needed to fully understand the economic and wellness benefits	Risk Assessment

References

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Gauthier N., White, J. 2020. Aboriginal peoples and agriculture in 2016: a portrait. *Canadian Agriculture at a Glance*. Minister of Industry, Statistics Canada ISSN 0-662-35659-4. https://www150.statcan.gc.ca/n1/pub/96-325-x/2019001/article/00001-eng.htm

Carter, S. Indigenous reserve agriculture 1900. *Indigenous Saskatchewan Encyclopedia*. University of Regina Press. Accessed Feb. 8, 2021: https://teaching.usask.ca/indigenoussk/import/indigneous_reserve_agriculture_to_1900.php

TOPIC 13. CHILDREN & ADOLESCENTS

| Children and adolescents depend on adults to provide safe home and farm |

- Children and youth on Canadian farms are at risk for injury, illness, and stress.
- Farms are places of both work and residential living.
- 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.
- All steps of the Hierarchy of Control must be implemented for prevention of injuries to children on farms and not just education alone.

Expert Panel: William Pickett, Brock University, St. Catherines, ON; Barbara Marlenga, Marshfield Clinic Research Foundation, Marshfield, WI; Don Voaklander, University of Alberta, Edmonton, AB; Valerie Elliot, Canadian Centre for Health and Safety in Agriculture, Saskatoon SK.

Applied Science Projects	Rationale	Hierarchy of Control
1. Identify ways to change beliefs among parents that risk exposure to children to farm hazards are outweighed by the benefits	Parents apparently prioritize the benefits of exposing young children to the farm work environment over the risks	Hazard Identification Risk Assessment Procedural Controls
2. 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
3. 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
5. Studies to assess developmental capability of youth handling various farm machinery and tasks	Safely operating machinery requires developmental and cognitive readiness and physical modifications	Risk Assessment Engineering Controls Procedural Controls
6. 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
7. Identify practical best practices to keep farm adolescents safe while highway driving	Young people from farms report high rates of substance use, and impaired driving	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.
Elliot V, Cammer A, Pickett W, Marlenga B, Lawson J, Dosman J, et al. (2018). Towards a deeper understanding of parenting on farms: A qualitative study. PLoS ONE 13(6): e0198796. https://doi.org/10.1371/journal.pone.0198796

TOPIC 14. 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 workers influence safety culture on the farm.
- 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.
- Cognitive impairment in some older workers.

Expert Panel: Don Voaklander, Injury Prevention Centre, Edmonton AB; William Pickett, Brock University, St. Catherines, ON; Debra Morgan, Canadian Centre for Health and Safety in Agriculture, Saskatoon, SK.

Applied Science Projects	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. Develop a module for use by grandparents to instill safety attitudes in grandchildren	Attempt to break established patterns of intergenerational transfer of attitudes	Hazard Identification Risk Assessment Procedural Controls
5. Engage older farmers and occupational safety professionals in a project to establish protocols for the passing of optimal health and safety practices between generations on the farm.	Older workers often set the tone for work culture on farms and pass on risks and protections to the next generations	Hazard Identification Risk Assessment Procedural Controls

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.
Elliot V, Cammer A, Pickett W, Marlenga B, Lawson J, Dosman J, et al. (2018). Towards a deeper understanding of parenting on farms: A qualitative study. PLoS ONE 13(6): e0198796. https://doi.org/10.1371/journal.pone.0198796

TOPIC 15. SEASONAL & MIGRANT WORKERS

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

- In 2018, there were seasonal and migrant workers from ~100 countries working in agriculture in Canada. Almost 90% of these workers came from just three countries (Mexico 51%, Guatemala 20%, Jamaica 18%).
- In 2018, over 54,734 international workers participated in the Seasonal Agricultural Worker Program or the Agricultural Stream of Canada's Temporary Foreign Worker Program.
- Seasonal workers are affected disproportionately by spread of COVID-19.
- Risks include exposure to pesticides, equipment, motorized vehicles, bobcats, forklifts and tractors, musculoskeletal disorders from repetitive movements or heavy lifting, biological exposures.
- Standards are required for housing, sanitary conditions, and access to potable water.
- Risks are exacerbated by language barriers and cultural differences.

Expert Panel: Linn Holness, University of Toronto, Toronto ON; Anil Adisesh, 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.

Applied Science Projects	Rationale	Hierarchy of Control
1. Establish a method of preventing infectious disease in seasonal workers	Current COVID-19 spread amongst workers on-farm housing	Risk Assessment Procedural Controls
2. Develop/assess policies for safe working conditions and worker occupational health and safety education	Inconsistent policies may violate human rights	Hazard Identification Risk Assessment Procedural Controls
3. Assess implementation of controls in other Canadians industries through workplace health and safety regulations	Ensure agreements contribute to fair relationships between stakeholders (Ex: examine open permits)	Risk Assessment Procedural Controls Engineering 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 workplace 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
7. Develop gender-based solutions to address workplace health and safety disparities and health care access.	Women are less likely to disclose health issues given the male-dominant work environment	Hazard Identifications Risk Assessment Procedural Controls

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APPENDIX 1: NATIONAL CONSULTATION

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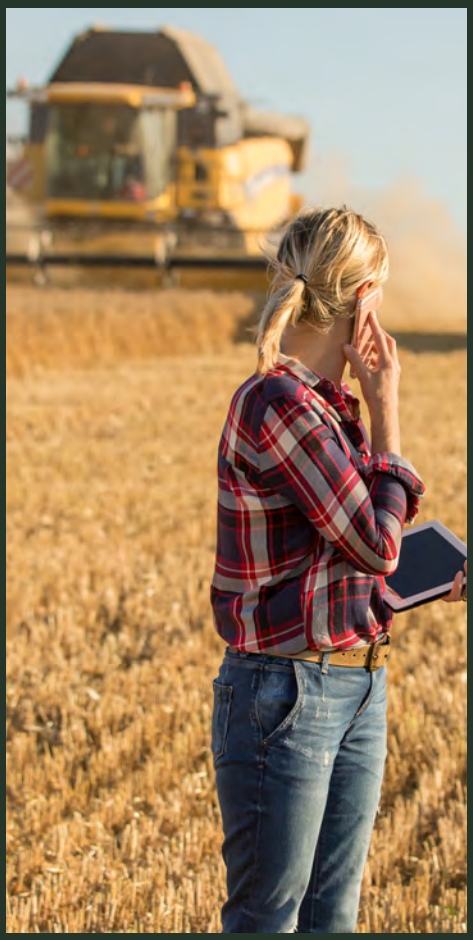

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