

The workplace must have a health and safety program that includes the full and equal participation of the Joint Health and Safety Committee, ongoing hazard and risk assessments, implementation of a hazard and risk management system that focuses on hazard elimination and educating workers on all aspects of health and safety.

As stated by Roelefs and Wegman (2014):³⁸³

“Attention to workers’ vulnerability means that climate change impacts as a set of occupational exposures should be anticipated and addressed through action by employers and regulatory agencies. The environmental justice framework calls on public agencies to recognize that the most vulnerable should not be the most impacted by potential environmental harm.”

Health and safety planning should include partnering with populations at highest risk:³⁸⁴

- Equity seeking groups
- Women
- Persons over age 65
- Newcomers
- New workers
- Young workers
- Outdoor workers

Canada’s Changing Climate Report has a new version each year (see figures on next three pages). Ensure the most current versions are used, including the report Health of Canadians in a Changing Climate, equity seeking group resources, federal and provincial government resources, etc.

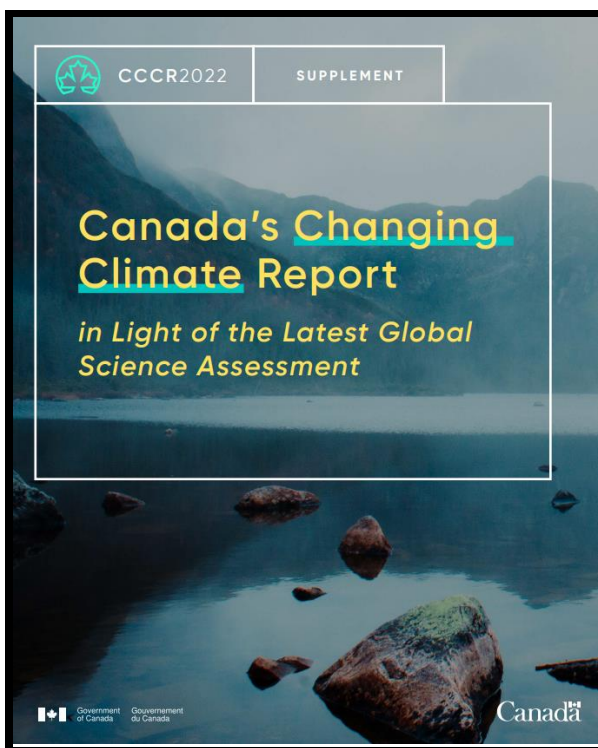
³⁸³ Roelofs, C. & Wegman, D. (2014). Workers: the Climate Canaries. Retrieved February 03, 2020 from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4167120/>

³⁸⁴ Health of Canadians in a Changing Climate. (2022). Retrieved June 08, 2022 from <https://changingclimate.ca/site/assets/uploads/sites/5/2022/02/CCHA-REPORT-EN.pdf>



New versions can be found at

<https://changingclimate.ca/site/assets/uploads/sites/2/2022/03/CCCR-2022-Supplement-Final.pdf>



Climate Planning & Action

CleanBC puts our province on a clear path to a cleaner, better future. Our 2018 plan includes significant actions that help us to use energy more efficiently and prevent waste, while making sure the energy we do use is the cleanest possible.

Explore Within ▾

Climate Adaptation & Preparedness

Our changing climate is already impacting people across British Columbia – from summer heat and wildfires to more frequent flooding and storm surges. Preparing for climate change is about understanding these changes and developing appropriate measures so we're ready for climate impacts now and in the future.

Explore Within ▾

Industry Innovation & Regulation

Industry plays a critical role in B.C.'s transition to a low-carbon future. Many are already reducing their emissions, and companies continue to drive innovation and adopt technology to cut their carbon costs.

Explore Within ▾

Data & Inventories

B.C. publishes a provincial greenhouse gas emissions inventory annually. Other GHG inventories include those reported by industrial facilities, carbon neutral PSOs, local governments and community level data.

Explore Within ▾

Provincial Public Sector Organizations

Our public sector is leading by example. Each year since 2010, B.C. has proudly achieved carbon neutral operations, maintaining a net impact of zero greenhouse gas (GHG) emissions across public sector organizations (PSOs) including health authorities, school districts, universities, colleges, institutes, Crown corporations and government offices.

Explore Within ▾

Local Governments

Communities in British Columbia play a vital role in creating a cleaner and more sustainable future for our province.

- [CleanBC highlights \(PDF\)](#)
- [CleanBC leaflet](#)
- [CleanBC for Small Business \(PDF\)](#)
- [CleanBC for Local Government \(PDF\)](#)

Climate Ready BC: Preparing Together

B.C. is developing a climate preparedness and adaptation strategy. Sign up for updates:

Climate Ready BC

- [Preparing for a Changing Climate \(leaflet PDF\)](#)
- [Preliminary Strategic Climate Risk Assessment](#)

Important Updates

- [CleanBC Job Readiness Plan Engagement](#)
- [B.C.'s public sector carbon neutral for 9th year running](#)
- [Active transportation strategy launched](#)
- [CleanBC Better Homes Rebates](#)
- [CleanBC Better Buildings](#)

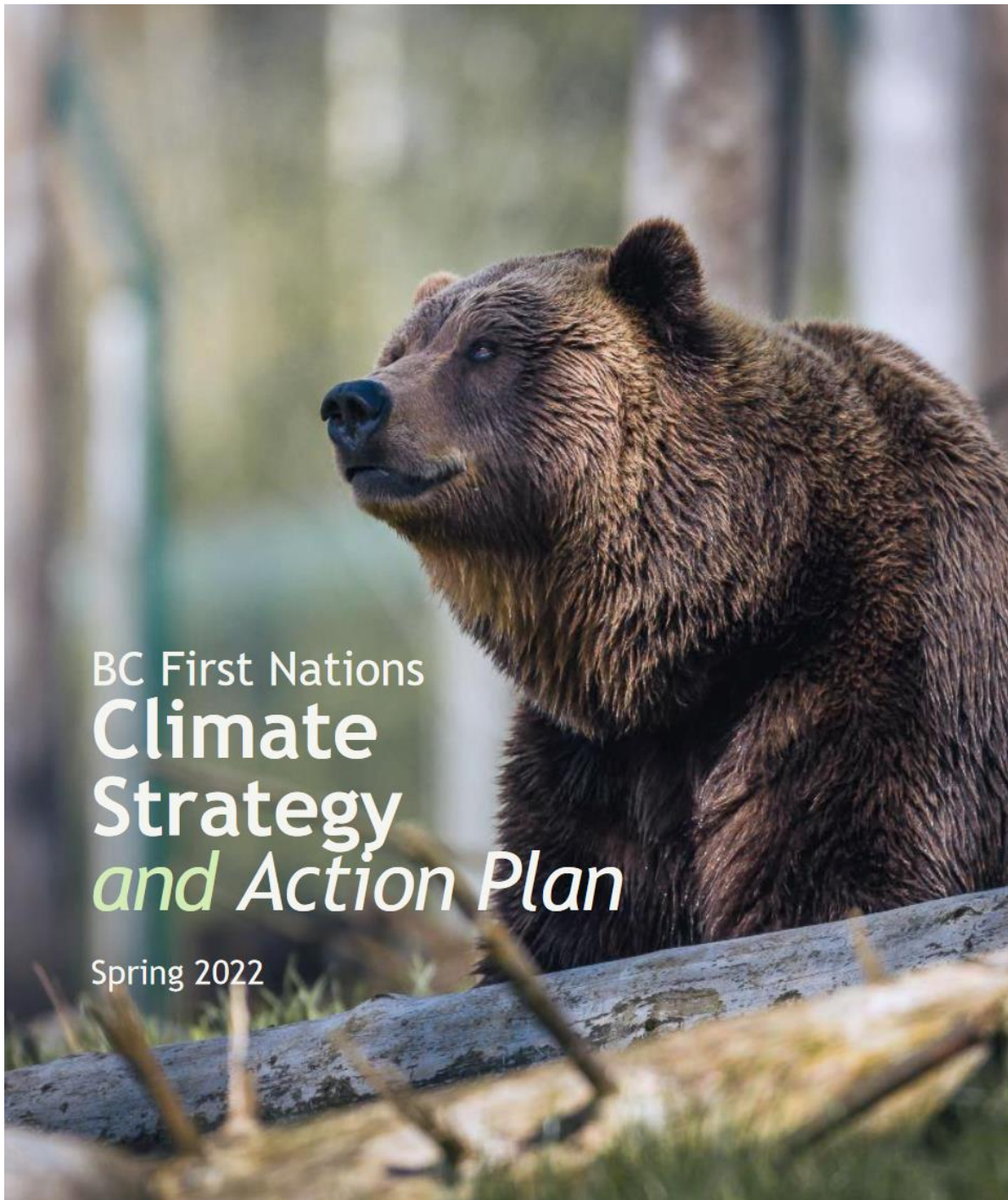
Government of British Columbia. Climate Change.

Regional Climate Change Impacts



Connolly, A. (September 27, 2019).

Here's how climate change will impact the region where you live. *Global News*.



BC First Nations Climate Strategy and Action Plan. Spring 2022.

VIII. Resources:

The following list of resources can be used for identifying and addressing hazards and risks in the workplace. There are numerous other documents online from municipal, provincial and federal governments (Canada, Europe, Australia and the US), universities, climate change resource centers, climate change action groups and private and public agencies. The following links to website resources may change without notice.

A Guide for Quebec Municipalities for Developing a Climate Change Adaptation Plan (ouranos)
Élaborer un plan d'adaptation aux changements climatiques : Guide destiné au milieu municipal québécois

See http://ouranos.ca/media/publication/111_PlanadaptationCCGuidemunicipalites-Ouranos.pdf

A Risk-based Guide for Local Governments

See http://adaptation.nrcan.gc.ca/tools/abosuj_e.php

American College of Occupational and Environmental Medicine

See [https://acoem.org/Learning/Journal-of-Occupational-and-Environmental-Medicine-\(JOEM\)](https://acoem.org/Learning/Journal-of-Occupational-and-Environmental-Medicine-(JOEM))

Association of Workers' Compensation Boards of Canada

See <http://awcbc.org/>

BC Centre for Disease Control

See <http://www.bccdc.ca/>

BC Centre for Disease Control. West Nile virus

See <http://www.bccdc.ca/health-info/diseases-conditions/west-nile-virus-wnv>

BC Federation of Labour ("BC Fed" / "BCFed"). Climate Change

See <https://bcfed.ca/issues/climate-change>

BC First Nations Climate Strategy and Action Plan. Spring 2022

See <https://www.bcafn.ca/news/bc-first-nations-climate-strategy-and-action-plan-released-earth-day>

British Columbia Assembly of First Nations

See <https://www.bcafn.ca/climate-emergency/bc-first-nations-climate-strategy-and-action-plan-development-progress-update#:~:text=The%20objective%20of%20the%20Strategy,resilience%20in%20First%20Nation%20communities>

Canada Communicable Disease Report

See <https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr.html>

Canada Communicable Disease Report. Zoonotic diseases caused by climate change

See <https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2019-45/issue-5-may-2-2019/article-5-observatory-climate-change-adaptation-quebec.html>

Canada Communicable Disease Report. Increased tick-borne diseases with climate change

See <https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2019-45/issue-4-april-4-2019/article-2-increased-risk-tick-borne-diseases-climate-change.html>

Canada Communicable Disease Report. What to expect with climate change

See <https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2019-45/issue-4-april-4-2019/article-1-climate-change-infectious-diseases.html>

Canadian Environmental Law Association

See <https://cela.ca/>

CAREX Canada

See <https://www.carexcanada.ca/>

CAREX Canada. Outdoor Air Pollution Profile

See https://www.carexcanada.ca/profile/outdoor_air_pollution/

CAREX Canada. Solar Radiation Profile

See https://www.carexcanada.ca/profile/uv_radiation_solar/

CAREX Canada. Solar Radiation. Burden of Occupational Cancer Fact Sheet

See https://www.carexcanada.ca/CAREX_OCRC_Burden_of_Occupational_Cancer_Solar_factsheet.pdf

Canadian Centre for Occupational Health and Safety (“CCOHS”)

See https://www.ccohs.ca/oshanswers/hsprograms/hazard_risk.html

Canadian Centre for Occupational Health and Safety. Ultraviolet Radiation

See https://www.ccohs.ca/oshanswers/phys_agents/ultravioletradiation.html

Canadian Centre for Occupational Health and Safety. Climate Change

See <https://ccohs.ca/newsletters/hsreport/issues/2019/06/ezone.html>

Canadian Centre for Policy Alternatives

See <https://www.policyalternatives.ca/projects/climate-justice-project>

Canadian Labour Congress (“CLC”). Climate Action

See <https://canadianlabour.ca/tag/climate-change>

Canadian Labour Congress. Climate Change Archives

See <https://canadianlabour.ca/tag/climate-change/>

Canadian Mental Health Association (“CMHA”). National Office

See <https://cmha.ca/>

Canadian Union of Public Employees
See <https://cupe.ca/health-and-safety>

Canadian Union of Public Employees. Climate change is a health and safety issue
See <https://cupe.ca/climate-change-health-and-safety-issue-0>

Canadian Union of Public Employees. Climate Literacy Tool
See <https://cupe.ca/cupes-climate-change-tool-goes-online>

Canadian Union of Public Employees. Climate Change Workshop
See <https://cupe.ca/climate-change-workshop>

Canadian Union of Public Employees. Collective solutions needed for climate change
See <https://cupe.ca/collective-solutions-needed-climate-change>

Canadian Union of Public Employees. Environment
See <https://cupe.ca/environment>

Centres for Disease Control and Prevention
See <https://blogs.cdc.gov/niosh-science-blog/2014/09/22/climate-change/>

Changing Climate, Changing Communities: Municipal Climate Adaptation Guide and Workbook
See www.iclei.org/index.php?id=11710

City of Vancouver. Climate Change Adaptation Strategy
See <https://vancouver.ca/green-vancouver/temperature-climate.aspx>

Climate Change and Health
See http://www.hc-sc.gc.ca/ewh-semt/climat/index_e.html

The Climate Change and Innovation Bureau at Health Canada
See <https://www.canada.ca/en/health-canada/programs/health-adapt.html>

CSA Group. CSA Z1003-13 Psychological Health and Safety in the Workplace
See <https://www.csagroup.org/article/cancca-z1003-13-bnq-9700-803-2013-r2018/>

CSA Group. Z1003 Implementation Handbook. Retrieved February 15, 2020
See <https://www.csagroup.org/article/spe-z1003-implementation-handbook/>

CSA Group CSA Z45001:19
See https://store.csagroup.org/ccrz_ProductDetails?sku=2704632

CSA Group IEC 31010:2019
See https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&cclcl=en_US&sku=iec_059809

CSA Group CAN/CSA 1002-12(R17)
See <https://www.csagroup.org/store/product/2703276/>

CSA Group CSA Z1010
See <https://standards.globalspec.com/std/10277463/CSA%20Z1010>

CSA Group CAN/CSA Z1000
See <https://webstore.ansi.org/Standards/CSA/CSAZ10002014>

Department of Fisheries and Oceans (Government of Canada)
See <https://www.dfo-mpo.gc.ca/index-eng.htm>

Disability Management Employer Coalition
See <http://dmec.org/>

Environmental Protection Agency (“EPA”). US. Climate Research
See <https://www.epa.gov/climate-research>

Government of BC. Climate Change
See <https://www2.gov.bc.ca/gov/content/environment/climate-change>

Government of BC. Heat Alert system

See <https://news.gov.bc.ca/releases/2022PSSG0035-000904>

Government of Canada. Adapting to Climate Change

See <https://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/municipalities/10079>

Government of Canada. Canada's Changing Climate Report

See <https://changingclimate.ca/CCCR2019/>

Government of Canada. Candida Auris

See <https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2018-44/issue-11-november-1-2018/article-1-candida-auris-management.html>

Government of Canada. Canadian Forest Fire Weather Index ("FWI") System

See <https://cwffis.cfs.nrcan.gc.ca/background/summary/fwi>

Government of Canada. Chikungunya

See <https://www.canada.ca/en/public-health/services/diseases/chikungunya.html>

Government of Canada. E. coli (Escherichia coli) infection

See <https://www.canada.ca/en/public-health/services/diseases/e-coli.html>

Government of Canada. Natural Air Pollution Surveillance ("NAPS") Network

See <https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/national-air-pollution-program.html>

Government of Canada. UV index and sun safety

See <https://www.canada.ca/en/environment-climate-change/services/weather-health/uv-index-sun-safety.html>

Government of Canada. Weather, climate and hazards

See <https://www.canada.ca/en/services/environment/weather.html>

Government of Canada. West Nile virus

See <https://www.canada.ca/en/public-health/services/diseases/west-nile-virus/surveillance-west-nile-virus.html>

Health of Canadians in a Changing Climate. February 2022

See <https://changingclimate.ca/site/assets/uploads/sites/5/2022/02/CCHA-REPORT-EN.pdf>

HealthLinkBC

See <https://www.healthlinkbc.ca>

Indigenuity Consulting Group

See <http://www.indigenuity.ca/>

International Journal of Occupational Medicine and Environmental Health

See <http://ijomeh.eu/>

International Labour Organization (“ILO”). Report “Working on a Warmer Planet The impact of heat stress on labour productivity and decent work”

See https://www.ilo.org/global/publications/books/WCMS_711919/lang--en/index.htm

International Organization for Standardization. ISO 7243

See <https://www.iso.org/home>

Institute for Work & Health (“IWH”)

See <https://www.iwh.on.ca/>

Journal of Occupational Medicine

See <https://www.nejm.org/doi/full/10.1056/NEJM195903192601211>

Municipal Resources for Adapting to Climate Change (Federation of Canadian municipalities)
See [www.sustainablecommunities.ca/files/Capacity_Building - PCP/ PCP_Resources/Mun-Re_Adapting-Climate-Change-e.pdf](http://www.sustainablecommunities.ca/files/Capacity_Building_-_PCP/PCP_Resources/Mun-Re_Adapting-Climate-Change-e.pdf)

Infrastructure Climate Risk Protocol (engineers Canada)
See www.pievc.ca

Municipal Heat Response Planning in British Columbia, Canada. BC Centre for Disease Control
See <http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/BC%20Municipal%20Heat%20Response%20Planning.pdf>

National Institute for Occupational Health and Safety (“NIOSH”)
See <https://www.cdc.gov/niosh/pubs/default.html>

Natural Air Pollution Surveillance (“NAPS”) Network
See <https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/national-air-pollution-program.html>

National Oceanic and Atmospheric Administration (“NOAA”)
See <https://www.noaa.gov/>

Occupational Safety and Health Administration (“OSHA”)
See <https://www.osha.gov/>

OHCOV
See <https://www.ohcov.on.ca/>

Pacific Climate Impacts Consortium
See <https://www.pacificclimate.org/>

Protecting your Community from Climate Change. A Training Program for Ontario Municipalities

See http://climateontario.ca/ORAC_Products.php

The Intergovernmental Panel on climate change

See www.ipcc.ch

WorkSafeBC

See <https://www.worksafebc.com/en>



IX. Terminology: (These definitions may change as the scientific literature regarding climate change is updated)

Here are a few terms that are commonly used regarding climate change:³⁸⁵

Adaptation: Adjustment in natural or human systems in response to actual or expected climate stimuli and their effects, which moderates harm or exploits beneficial opportunities. There are various types of adaptation, including anticipatory, autonomous and planned adaptation.

Adaptive capacity: The whole of capabilities, resources and institutions of a country, region, community or group to implement effective adaptation measures.

³⁸⁵ BBC, CBC, CCOHS, CUPE, NIOSH, NOAA, Government of BC, Government of Canada, Wikipedia

Climate: Climate in a narrow sense is usually defined as the average weather or, more rigorously, as the statistical description in terms of the mean and variability of relevant variables over a period of time ranging from months to thousands or millions of years. Variables considered most often include surface temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

Carbon dioxide (CO₂): Carbon dioxide is a gas in the Earth's atmosphere. It occurs naturally and is also a by-product of human activities such as burning fossil fuels. It is the principal greenhouse gas produced by human activity.

Carbon dioxide (CO₂) equivalent: Six greenhouse gases are limited by the Kyoto Protocol and each has a different global warming potential. The overall warming effect of this cocktail of gases is often expressed in terms of carbon dioxide equivalent - the amount of CO₂ that would cause the same amount of warming.

Carbon footprint: The amount of carbon emitted by an individual or organisation in a given period of time, or the amount of carbon emitted during the manufacture of a product.

Climate: The average of the weather patterns in a location over a longer period of time, usually 30 years or more.

Climate change: See “Weather” as well. Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and / or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing factors, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations Framework Convention on Climate Change (“UNFCCC”) defines climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.

Climate projection: The calculated response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based on simulations by climate models. Because climate projections are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized, they are therefore subject to substantial uncertainty.

Climate scenario: A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships and assumptions of radiative forcing, typically constructed for explicit use as input to climate change impact models. A “climate change scenario” is the difference between a climate scenario and the current climate.

Climate variability: Variations in the mean and other statistics (e.g. standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system or to variations in natural or anthropogenic external forcing.

Ecoanxiety (or climate anxiety): Refers to the anxiety people experience that is triggered by awareness of ecological threats facing the planet due to climate change.

Ecoparalysis: Refers to the complex feelings of not being able to do anything grand enough to mitigate or stop climate change.

Ecological grief (or ecogrief): Refers to distress related to ecological loss or anticipated losses related to climate change. These losses may relate to land, species, culture or lost sense of place and / or of cultural identity and ways of knowing. Ecogrief can include loss and trauma related to specific hazards such as climate related flooding or wildfires, or slow-onset climate change impacts such as rising global temperatures, drought, melting permafrost and sea-level rise.

Emotional distress: Refers to experiencing symptoms of poor mental health outcomes (e.g. anxiety, depression, loss of motivation). The term mental ill health encompasses the definitions of mental challenges, formally diagnosable mental illnesses and emotional distress.

Extreme weather event: An event that is rare within its statistical reference distribution at a particular place. Definitions of “rare” vary, but an extreme weather event would normally be as rare as, or rarer than, the 10th or 90th percentile. By definition, the characteristics of what is called “extreme weather” may vary from place to place.

Fire weather: Changing precipitation and temperature (along with changing wind) that alter the risk of extreme wildfires and arise from hot, dry and windy conditions.

Greenhouse gas: Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth’s surface, by the atmosphere itself and by clouds. Water vapour (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and ozone (O₃) are the primary greenhouse gases in the Earth’s atmosphere. In addition, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances.

Greenhouse effect: The insulating effect of certain gases in the atmosphere, which allow solar radiation to warm the earth and then prevent some of the heat from escaping. See also natural greenhouse effect.

Global warming: The steady rise in global average temperature in recent decades, which experts believe is largely caused by man-made greenhouse gas emissions. The long term trend continues upwards, they suggest, even though the warmest year on record, according to the UK's Met Office, is 1998.

Global Warming Potential (GWP): A measure of a greenhouse gas's ability to absorb heat and warm the atmosphere over a given time period.

Hazard: The CSA Z1002 Standard "Occupational health and safety - Hazard identification and elimination and risk assessment and control" uses some outdated definitions and terms: harm is a physical injury or damage to health and hazard as a potential source of harm to a worker. These are too narrow as they exclude most of the WorkSafeBC and other provincial occupational health and safety definitions of hazard including occupational diseases, damage to property, damage to equipment, near misses / hits, etc. The definition of hazard, harm and risk must be as expansive as possible and must be updated regularly to adapt to changing conditions, science, legislation, regulations and site specific hazard and risk assessments. See WorkSafeBC Identifying Hazards at <https://www.worksafebc.com/en/health-safety/create-manage/managing-risk/identifying-hazards>.

Impacts: The adverse and beneficial effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts.

Intergovernmental Panel on Climate Change ("IPCC"): A panel established by the World Meteorological Organization ("WMO") and the United Nations Environment Programme ("UNEP") in 1988 to assess scientific, technical and socioeconomic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation.

Kyoto Protocol: A protocol attached to the UN Framework Convention on Climate Change, which sets legally binding commitments on greenhouse gas emissions. Industrialised countries agreed to reduce their combined emissions to 5.2% below 1990 levels during the five-year period 2008-2012. It was agreed by governments at a 1997 UN conference in Kyoto, Japan, but did not legally come into force until 2005. A different set of countries agreed a second commitment period in 2013 that will run until 2020.

Mainstreaming: In the context of adaptation, mainstreaming refers to the integration of adaptation considerations (or climate risks) such that they become part of policies, programs and operations at all levels of decision making. The goal is to make the adaptation process a component of existing decision making and planning frameworks.

Mental wellness: Refers to affirmative mental health outcomes, such as psychosocial resilience, which is the ability to adapt, thrive, develop and transform despite experiencing stressors.

Mental challenges: Include problems related to thoughts, feelings or behaviours, such as overwhelming emotions, including fear, panic and worry (American Psychiatric Association, n.d.).

Mental illness: Includes moderate to severe diagnosable mental disorders, such as major depressive disorder, psychosis and PTSD (American Psychiatric Association).

Mitigation: In the context of climate change, mitigation is an anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks.

“No regrets” policy / measure: A policy or measure that would generate net social and / or economic benefits irrespective of whether or not climate change occurs.

Permafrost: Ground (soil or rock and included ice and organic material) that remains at or below 0°C for at least two consecutive years.

Ozone: Ozone (O₃) is a gas molecule composed of three oxygen atoms. Ozone develops in the atmosphere from gases that come out of tailpipes, smokestacks and many other sources. When these gases come in contact with sunlight, they react and form ozone smog.

Pathogen: A pathogen can be a virus, bacterium, fungus, parasite, amoeba or a prion. Pathogens may cause disease.

Precautionary principle: It absorbs notions of risk prevention, cost effectiveness, ethical responsibilities toward maintaining the integrity of human and natural systems and the fallibility of human understanding. The application of the precautionary principle or approach recognizes that the absence of full scientific certainty shall not be used to postpone decisions where there is a risk of serious or irreversible harm.

Resilience: The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the same capacity for self-organization and the same capacity to adapt to stress and change.

Risk: A combination of the likelihood (probability of occurrence) and the consequences of an adverse event (e.g. climate related hazard).

Risk management: A systematic approach to setting the best course of action under uncertainty, by applying management policies, procedures and practices to the tasks of analysing, evaluating, controlling and communicating about risk issues.

Salt-water intrusion: Displacement of fresh surface water or groundwater by the advance of salt water due to its greater density. This usually occurs in coastal and estuarine areas due to reducing land-based influence (e.g. either from reduced runoff and associated groundwater recharge or from excessive water withdrawals from aquifers) or increasing marine influence (e.g. relative sea-level rise).

Sea ice: Any form of ice found at sea that has originated from the freezing of sea water. Sea ice may be discontinuous pieces (ice floes) moved on the ocean surface by wind and currents (pack ice) or a motionless sheet attached to the coast (land-fast ice). Sea ice less than one year old is called first-year ice. Multiyear ice is sea ice that has survived at least one summer melt season.

Sea-level rise: An increase in the mean level of the ocean. Eustatic sea-level rise is a change in global average sea level brought about by an increase in the volume of the world ocean. Relative sea-level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and / or land-level subsidence. In areas subject to rapid land-level uplift, relative sea level can fall.

Sensitivity: Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or climate change. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g. damage caused by an increase in the frequency of coastal flooding due to sea-level rise).

Smog: Smog is primarily made up of ground level ozone combined with other gases and particle pollution.

Stakeholder: A person or an organization that has a legitimate interest in a project or entity or would be affected by a particular action or policy.

Storm surge: Generally used to refer to a temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and / or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place. Negative storm surges also occur and can present significant problems for navigation.

Tools (for adaptation): Methodologies, guidelines and processes that enable stakeholders to assess the implications of climate change impacts and relevant adaptation options in the context of their operating environment. Tools may occur in a variety of formats and have diverse applications: crosscutting or multidisciplinary (e.g. climate models, scenario-building methods, stakeholder analysis, decision support tools, decision analytical tools) to specific sectoral applications (e.g. crop or vegetation models, methods for coastal-zone vulnerability assessment).

Traditional knowledge: A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment.

Vulnerability: Vulnerability is the susceptibility to be harmed. Vulnerability to climate change is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability to climate change is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity.

Weather: Weather is the state of the atmosphere at a particular location over the short term. Climate is the average of the weather patterns in a location over a longer period of time, usually 30 years or more.

X. Appendices:

Appendix A: CSA Z1010 Management of work in extreme conditions:

(Partial Standard for illustration purposes only)

“Preface

This is the first edition of CSA Z1010, Management of work in extreme conditions. It is based on an Express Document, CSA EXP1010, published in 2016.

The purpose of this Standard is to address the application of occupational health and safety management systems to plan for work performed under heightened-risk conditions presented by extreme environmental temperatures, severe weather, low or high atmospheric pressure, and poor air quality (causing impairment of breathing or visibility). CSA Z1010 is the latest addition to the Z1000 series of OHS management systems standards. It is designed to be used within an OHS management system in conjunction with the other standards in the Z1000 series.

Introduction

0.1 General

Environmental conditions whether outside or inside buildings encountered by workers can have a significant adverse effect on their health and safety. Completion of work tasks could be slowed or quality diminished as a result of exposure to extreme environmental/weather conditions.

The effects of extreme conditions can be both physiological and/or psychological. For example: physiological effects are determined by the ability of muscle cells to transform chemically bound energy from food intake into mechanical energy for muscular work. This process can be impaired by factors that reduce oxygen and fuel availability to muscle tissue. Psychological factors, including motivation and focus can also be influenced by the

environmental conditions that the workers experience*. The ultimate result can be injuries, occupational illness, reduced work output or decreased quality of work performed.

In many instances, environmental conditions cannot be controlled (or even accurately predicted). Changing conditions can heighten risk and create new hazards.

* Rodahl, K. (2003) "Occupational Health Conditions in Extreme Environments", The Annals of Occupational Hygiene, Vol. 47, Issue 3, UK.

0.2 Content of this Standard

This Standard specifies the requirements for a management system for managing work performed both indoors and outdoors under conditions of:

- a) extreme heat (elevated temperatures);
- b) elevated humidity levels;
- c) extreme cold;
- d) high wind;
- e) extreme levels of precipitation;
- f) severe weather;
- g) high altitude;
- h) high and low atmospheric pressure conditions; and
- i) diminished visibility (e.g. absence of light, fog, smoke, smog, etc.).

In addition, this Standard addresses risk escalation factors such as those presented by complex terrain and remoteness of the work site.

This Standard is intended to be consistent with CAN/CSA-Z1000 in that a program to manage work in extreme environmental conditions can be integrated into an organization's existing occupational health and safety management system

This Standard specifically addresses hazards and risk assessment (Clauses 5, 6, and 7), program planning and implementation (Clauses 8 and 9), and emergency preparedness (Clause 11). Examples of safe work programs, other resources, and cross references to other related standards are included in the Annexes.

This Standard also provides advice for dealing with unforeseen hazards and deteriorating conditions – when to stop work, and when to evacuate.

Scope

1.1

This Standard, following the principles set out in CAN/CSA-Z1000, specifies requirements for

- a) establishing and maintaining an extreme conditions management system in accordance with occupational health and safety management system (OHSMS) principles;
- b) the roles and responsibilities of the management representative, the monitoring team, and the worker;
- c) management of external service providers;
- d) establishing the parameters of extreme conditions;
- e) hazard identification and risk assessment relating to work in extreme conditions, including
 - i) high winds, tornados, hurricanes;
 - ii) extreme temperatures, hot and cold, humidity and wind-chill;

- iii) heavy rain, lightning, flash flooding;
 - iv) icy conditions — ice buildup, slippery conditions, sleet and hail;
 - v) poor visibility (e.g., absence of light, fog, smoke, smog, etc.);
 - vi) terrain — rough, rocky, uneven, sloped;
 - vii) high altitude — low atmospheric pressure, hyperbaric – pressurized atmosphere; and
 - viii) ice roads — thickness, travel safety both individually and in combination, as well as considering risk escalation factors; and
- f) management and control of hazards and risk relating to work in extreme conditions, including
- i) development of general safety procedures for extreme conditions;
 - ii) personal protective equipment (PPE) and apparel used for work in extreme conditions;
 - iii) health and safety monitoring systems for work in cold, damp, and high winds, as well as work in extreme heat and high humidity (both indoors and outdoors);
 - iv) health and safety monitoring systems for inclement weather and storms involving high winds, heavy rains, tornados, sleet and hail, lightning, and other severe weather conditions;
 - v) health and safety monitoring systems for work at high altitude, low atmospheric conditions and pressurized atmosphere, hyperbaric conditions (individually or in combination);
 - vi) emergency rescue plan development and implementation;
 - vii) travel/transportation to and from workplace;
 - viii) training for work in extreme conditions; and

ix) determining fitness for work in extreme conditions.

1.2

This Standard does not specifically address safety management of

- a) exposure to ionizing radiation;
- b) toxic or caustic atmospheres;
- c) high-noise and high-vibration environments;
- d) work in underwater environments;
- e) exposure to dangerous animals, insects, or plants; and
- f) man-made conditions resulting from socio-political situations.

1.3

This Standard is designed to be used with related health and safety management standards, as well as related procedural standards. It is intended to be referenced by other standards as the primary set of requirements for health and safety management of work in extreme conditions. Although this Standard takes into consideration provincial, territorial, and federal legislation, it is not constrained by these regulations. It is intended to be used in conjunction with all provincial, territorial, or federal jurisdictions, and is designed for use in workplaces in all regions of Canada.

1.4

This Standard is designed for voluntary application in Canadian workplaces. However, the principles established in this Standard are based on best practices recognized internationally. As such, they may be applied to any workplace involving extreme conditions.

1.5

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a




recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.


Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.”

Appendix B: CAREX Canada Solar Radiation. Burden of Occupational Cancer Fact Sheet:



Solar Radiation

Burden of Occupational Cancer Fact Sheet



WHAT IS SOLAR RADIATION?

Solar radiation is the **main natural source of exposure to ultraviolet radiation**. Levels of exposure vary depending on geography, seasonality, time of day and meteorology, as well as time spent out of doors and the amount of skin exposed. All outdoor occupations have a potential for exposure to solar radiation. The International Agency for Research on Cancer classifies solar radiation as a **known carcinogen (IARC 1)**.

WHAT ARE ITS HEALTH EFFECTS?

• Skin cancer	• Heat stress/stroke	• Cataracts
• Sunburns	• Thick, scaly skin patches	• Eye lesions and cancer

THE BURDEN OF SKIN CANCER FROM WORKPLACE EXPOSURE TO SOLAR RADIATION IN CANADA

The term 'burden' refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

4,600
Skin cancers due to workplace sun exposure

Approximately **4,600 non-melanoma skin cancers** are due to occupational solar radiation each year, based on past exposures (1961-2001). This amounts to **6.3% of non-melanoma skin cancer cases** diagnosed annually.

WHAT IS THE ECONOMIC IMPACT?

Work-related solar radiation exposure resulted in approximately **\$34.2 million in costs for newly diagnosed non-melanoma skin cancer cases** in 2011.

This includes approximately:

- 17% in health-related quality of life losses
- 58% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
- 25% in indirect costs including output and productivity losses

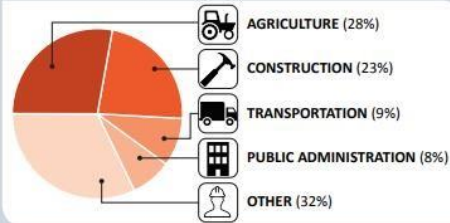
\$34.2 million
Estimated yearly cost of non-melanoma skin cancer due to workplace sun exposure

Solar Radiation

2019

WHAT WORKERS ARE MOST AFFECTED?

Most occupational non-melanoma skin cancers associated with solar radiation occur among workers in the **agricultural** and **construction sectors** (see pie chart on right). These cancers also occur among workers in the transportation and public administration sectors. Some of the other sectors affected include forestry and logging, manufacturing, and mining and oil and gas extraction.



CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO SOLAR RADIATION

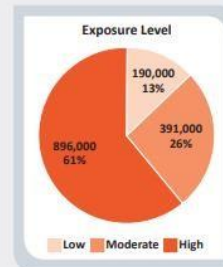
Exposure to solar radiation can occur via skin or eyes.
Approximately 1.5 million Canadians are exposed to solar radiation at work.

Industries with the largest number of exposed workers in Canada include:

- **Construction (all types)** (343,000 people exposed)
- **Farms** (264,000 exposed)
- **Services to buildings and dwellings** (83,000 exposed)

Occupations with the largest number of exposed workers include:

- **Farmers and farm managers** (150,000 exposed)
- **Construction trades helpers and labourers** (125,000 exposed)
- **Landscaping and ground maintenance labourers** (115,000 exposed)



Results show the majority of workers exposed to solar radiation are in the high exposure level category, with a significant number at risk for low to moderate exposure (see pie chart above). To learn more about how these exposure levels are defined, visit the CAREX Canada website.

HOW CAN EXPOSURE BE REDUCED?

Providing shade is the best way to protect workers from solar radiation. Other controls include modifying reflective surfaces, tinting windows on vehicles, and minimizing time spent in the sun during peak UV hours (11am – 3pm). Sun Safety at Work Canada provides resources on how workplaces can develop and implement sun safety programs. For more details, visit the OCRC exposure controls webpage.

ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study quantified the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It was a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health (who led the economic analyses), University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.



For more information, please visit OCRC at www.occupationalcancer.ca or CAREX Canada at www.carexcanada.ca.

This fact sheet was produced by CAREX Canada in partnership with OCRC. The Burden of Occupational Cancer Study is led by OCRC and is supported by the Canadian Cancer Society. CAREX Canada is hosted at Simon Fraser University and supported by the Canadian Partnership Against Cancer. Acknowledgments for header photos: Queensland Health, Highways Agency, Cj Berry, Peter Thoeny.



Solar Radiation

2019

Appendix C: Canada's Changing Climate Report – 2019 (cover page):



https://changingclimate.ca/site/assets/uploads/sites/2/2019/04/CCCR_FULLREPORT-EN-FINAL.pdf

Appendix D: Injury Prevention for Workers in Precarious Employment & New and Young Workers 2018:

INJURY PREVENTION FOR WORKERS IN PRECARIOUS EMPLOYMENT & NEW AND YOUNG WORKERS 2018

A REVIEW OF THE ISSUES, STATISTICS, LEGISLATION AND SOURCES OF INFORMATION

***Workers under the age of 25 account for one third of workplace injuries.
More than 50% of young workers were hurt in the first 6 months of
employment.***

I. BACKGROUND

Precarious work (also referred to as non-standard employment) is described as any deviation from standard employment and is characterized as being temporary or casual in nature, lacking benefits, lacking in certain legal protections, and usually associated with lower income. Some workers are more likely to be overrepresented in precarious employment, such as women, newcomers to Canada, young and new workers and racialized workers. Any reference to “precarious workers” is meant to mean precarious employment. One primary issue is the impact on worker’s health and safety as well as Collective Agreement entitlements. Due to changing definitions of precarious work, lack of consistent statistics on the prevalence of precarious work and the underreporting of injuries, the need for worker awareness is greater than ever.



***The 2014 CUPE
Membership Survey
Results for Equality
indicated that 25% of
CUPE members were in
precarious work.***

II. EXTENT OF THE PROBLEM

The workers identified in Section I are at high risk of employment related injuries.¹ As per WorkSafeBC (WCB) “young and new workers need special attention because they are at more risk of injury than their older or more experienced counterparts. The injury rate for young male workers is much higher than that of the overall population.” In terms of occupational health and safety, WorkSafeBC defines a young worker as “any worker who is under 25 years of age” per “Support for Employers Training and Orientation for Young and New Workers an Employer’s Guide to Part 3 of the Occupational Health and Safety Regulation.”

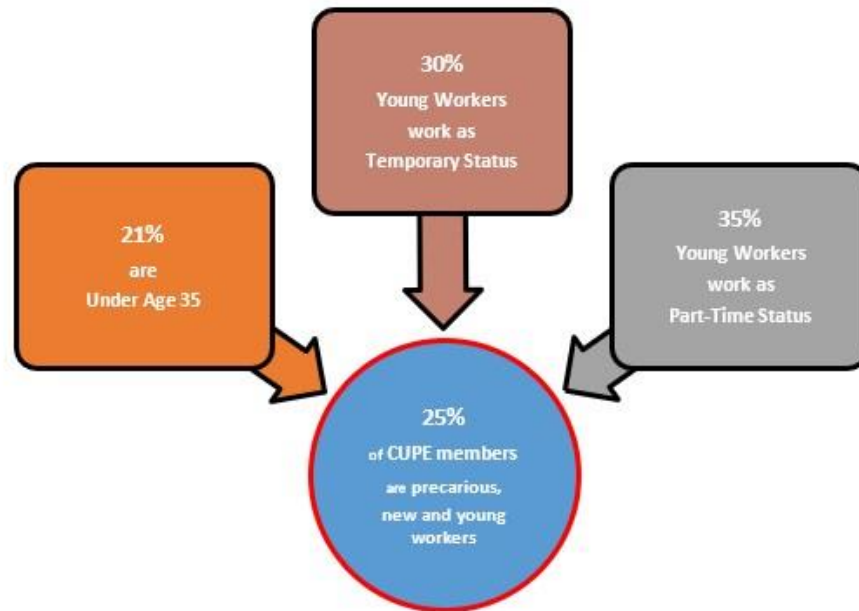
The 2014 CUPE Membership Survey Results for Equality indicated that 25% of CUPE members were in precarious employment. Data from CUPE is summarized in Figure 1 below.

Various agencies and private bodies have different statistics and definitions for young workers and workers in precarious employment. In 2014, 21% of workers were under the age of 35 as per a TD Special Report.² As many as 30% of young workers are in temporary employment and 35% are in part-time employment.³ In 2014, Statistics Canada released data on employment showing that 15.3% of Canadians were self-employed, 5.3% were involuntarily employed part time, and 11.3% were in a temporary job. Statistics Canada then reported in 2016 that 19% of workers were in part-time employment and 13% of workers were in temporary employment. These statistics have changed marginally since then and have remained relatively consistent since 2011 overall except for small annual increases in part-time employment and temporary employment for all age groups each year. As per the Ontario Law Commission, approximately 22% of jobs (in Ontario) could be characterized as precarious work, defined as having low wages and at least two of three other features: no pension, no union and/or small firm size. Part-time workers are more likely to be precariously employed than full-time workers (with about 33% of part-time workers being employed in positions with low wages, no union and no pension). Nationally, 33% of new Canadians reporting that they have entered self-employment because of a lack of suitable paid jobs as compared to 20% of Canadian-born workers. As per the Victoria Times Colonist (January 2018) “workers currently stay in a job for an average of 4.4 years, a number that has been steadily declining for decades.” Few studies address short-term duration employment.

The sectors most impacted by precarious employment include culture, education, recreation, information and food services as per Statistics Canada.

Women are far more likely to be engaged in precarious work than men. Women also face a substantially greater risk of occupational injury relative to men when working in the same job as per Section III below. Job insecurity plays a role in creating and sustaining occupational health disparities.⁴

FIGURE 1:



25% of CUPE Members Nationally are in Precarious Employment or are New and Young Workers

III. HIGHER RISK OF INJURY AND FATALITIES

There are numerous risk factors associated with precarious work. These include gender, age, ESL issues, literacy issues, exposure to hazards, training, employee orientation, unionization, employment sector and injury rates. The following sections review several of these areas.

More than 50% of young workers were hurt in the first 6 months of employment. New workers in general are 3 times more likely to be injured during their first month of employment.



III.I. DIMENSIONS OF RISK

As per the Canadian Centre for Occupational Health and Safety (CCOHS) and the Institute for Work and Health (IWH) the IWH study identified four primary “vulnerability dimensions” that lead to increased risk of injury:

- Actual workplace risks and hazards workers experience.
- Workplace or organizational-level protection workers are/are not offered in the form of policies and practices.
- Awareness of Occupational Health and Safety Rights and responsibilities.
- Extent to which workers are empowered to take part in work-related injury prevention and refuse unsafe work.

III.II. EXPOSURE TO HAZARDS

The CCOHS⁵ also noted that workers in precarious employment:

- Are more often exposed to hazardous work environments, stressful psychosocial working conditions, increased workload, including unpaid overtime,
- Suffer a higher rate of occupational safety and health injuries,
- Experience ill health effects,
- Experience increased work-life conflict,
- Are less likely to receive adequate training for the tasks they are required to perform,
- Are less likely to be members of trade unions, and
- Have less protection due to limitations, loopholes and exclusive interpretations of legislation.

The Law Commission of Ontario⁶ identified the following risks to workers in precarious employment:

- Lack of training
- Irregular hours
- Long hours
- Lack of knowledge about OHS rights and obligations
- Having multiple jobs
- Lack of access to safe transportation
- Lack of access to nutritious food
- Lack of rest
- Lack of medical care

The Public Health Agency of Canada identified several factors related to injury rates along young workers as per the May 2016 "Occupational injuries in Canadian youth: an analysis of 22 years of surveillance data collected from the Canadian Hospitals Injury Reporting and Prevention Program." These were:

- Inexperience
- Lack of sufficient training
- Differential hazards and risks



Women have injury rates 20% to 40% higher than men in the same job. Women between 25 and 64 experience more frequent injuries but are less likely to file a WorkSafeBC claim.

III.III. INJURY RATES

The injury rate for young male workers is 3 to 5 times higher than the general population.⁷ As per the British Columbia Federation of Labour, workers under the age of 25 account for one third of workplace injuries. More than 50% of young workers were hurt in the first 6 months of employment. New workers in general are 3 times more likely to be injured during their first month of employment.⁸

Nearly 20% of fatalities and injuries for both new and young workers occur during the first month of employment.⁹ As per the Institute for Work & Health "Over a 10-year period, the risk of work injury for workers with shorter job tenure has consistently remained higher compared to those employed at a job for more than one year. Risk is particularly elevated among those in the first month on the job, with over three times the risk of a lost-time injury as workers with over a year's job experience."

This data was echoed by Medscape where it stated that "Precarious workers present significantly higher injury rates than those with secure careers, with an increase in risk between 24 and 57% ($p < 0.05$)."¹⁰ The primary causes of injuries for new and young workers in that data was overexertion and being struck by objects.

The Public Health Agency of Canada noted very high injury rates among very young workers per the May 2016 "Occupational injuries in Canadian youth: an analysis of 22 years of surveillance data collected from the Canadian Hospitals Injury Reporting and Prevention Program."¹¹ It stated that "surveys of American and Canadian middle-schoolers found that 18% of working 10 to 14 year-olds reported work injuries from summer jobs and 49.7% of wage-earning 12- to 14 year-olds reported work injuries in the past year" and "Across occupational categories, youth employed in the manual and goods-producing sector have a greater risk of sustaining injuries that result in work disability absence or increased lost-time WC claims compared to those in the service sector." More importantly, the statistics do not include the injuries of young workers who are not covered by or are ineligible for Workers Compensation. The study stated that "Since youth are more likely to engage in temporary, casual, contract or seasonal work than adults and the youngest workers frequently work in informal or self-employment arrangements such as farm work, babysitting or with family businesses that are not compulsorily or reliably covered in all provinces, claims data may underestimate youth injuries. This is compounded by general underreporting of work-related injuries by young employees because they fear reprisals, feel powerless or think their employer disregards concerns or because they are not aware of the reporting channels."

The most common types of injuries for young workers, per the study, were:

- Open wounds (all genders): 32.3%
- Open wounds (male): 36.5%
- Open wounds (female): 24.9%
- Musculoskeletal injuries (all genders): 22.3%
- Musculoskeletal injuries (male): 19.0%
- Musculoskeletal injuries (female): 28.1%

The food and beverage sector had the highest rate of emergency department visits among young workers age 10 to 17 (35.4%). Construction and trades had the highest hospitalization rate among young workers age 10 to 17 (21%). See Appendix 2.

Despite these statistics, the vast majority of young workers take a "wait-and-see" approach when they have safety concerns and usually do not report injuries to WorkSafeBC.¹³

Between the ages of 25 and 64, women had injury rates 20% to 40% higher than men in the same job and while working the same number of hours.¹⁴ Women between 25 and 64 experienced more frequent injuries but were less likely to file a WorkSafeBC claim. This is exacerbated when women are in precarious employment.

Employers have to do more. Temporary employment agencies have some of the worst injury and safety statistics. Per the study "How Precarious Employment Affects Health and Safety at Work: The Case of Temporary Agency Workers" it stated that "Amongst injured agency workers, 16% and 20% were known to have received induction from the agency and host respectively, but such data were missing from 59% of the files." See Appendix 3 as well for US statistics.



IV. WORKSAFEBC PREVENTION AND COMPENSATION LEGISLATION, REGULATIONS AND POLICIES

Precarious, new and young workers need to be aware of their rights and receive more extensive frequent training. The rights every worker needs to be aware of include:

- The right to refuse unsafe work.
- The right to participate in the workplace health and safety activities through Joint Health and Safety Committees or as a Worker Health and Safety Representative.
- The right to know, or the right to be informed about, actual and potential dangers in the workplace.
- The right to no discrimination or retaliation.

IV.I. WORKERS COMPENSATION ACT

- Section 5 Compensation for Personal Injury
- Section 6 Occupational Disease
- Section 115–117 reviews the responsibilities and general duties of employers, workers (all) and supervisors.

IV.II. WORKSAFEBC OHS REGULATIONS

- 3.1 to 3.3 Occupational Health and Safety Programs
- 3.10 Reporting hazards in the workplace
- 3.12 to 3.13 Right to Refuse Unsafe Work
- 3.22 to 3.25 Young or New Workers
- 4.21 to 4.23 Procedures for working alone or in isolation*
- 4.27 to 4.31 Violence in the Workplace**
- 8 Personal Protective Equipment
- Workplace Hazardous Materials Information System (WHMIS) and the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), including the safety Data Sheets for hazardous products

IV.III. REHABILITATION SERVICES AND CLAIMS MANUAL (USUALLY VOLUME II)

- 3-12.00 - 3-23.30 Compensation for personal injury
- 25.00 - 32.85 Compensation for occupational disease
- 92.00 - 100.83 Claims procedures

IV.IV. THE EMPLOYMENT STANDARDS ACT (there are no specific provisions directly relating to precarious work and injury prevention)

IV.V. OTHER POTENTIALLY APPLICABLE LEGISLATION

- The *Agricultural Employees Protection Act*
- The *Employment Protections for Foreign Nationals Act*
- The *Human Rights Code / Act*
- The Immigration and Refugee Protection Regulations
- The Canadian Charter of Rights and Freedoms

V. SOURCES OF ADDITIONAL INFORMATION AND ASSISTANCE

CUPE has many resources available, including WorkSafeBC claims, appeals and Occupational Health & Safety (Prevention) materials, Guides, Templates, Forms and Power points. CUPE National has a new Health and Safety Learning series as well. See below for additional resources and contact numbers.

V.I. LINKS TO ADDITIONAL RESOURCES

<http://cupe.ca/health-and-safety-facts-new-and-young-workers>

<http://cupe.ca/health-and-safety>

<http://cupe.ca/health-safety-learning-series>

[http://www.cupe.bc.ca/occupational health and safety committee](http://www.cupe.bc.ca/occupational_health_and_safety_committee)

<https://www.healthandsafetybc.ca/resources/young-worker-resources/>

(BC FEDERATION OF LABOUR YOUNG WORKER RESOURCES)

<https://www.healthandsafetybc.ca/programs/young-workers/>

(BC FEDERATION OF LABOUR "ALIVE AFTER 5" PROGRAM)

<http://www.ccohs.gc.ca/oshanswers/legisl/vulnerable.html>

(CANADIAN CENTRE FOR OCCUPATIONAL HEALTH AND SAFETY)

<http://www.lco-cdo.org/en/our-current-projects/vulnerable-workers-and-precarious-work/vulnerable-workers-interim-report-august-2012/quick-facts-about-vulnerable-workers-and-precarious-work/>

(LAW COMMISSION OF ONTARIO [QUICK FACTS ABOUT VULNERABLE WORKERS AND PRECARIOUS WORK])

http://www.ilo.org/wcmsp5/groups/public/-ed_dialogue/-actrav/documents/meetingdocument/wcms_179787.pdf

(INTERNATIONAL LABOUR ORGANIZATION. FROM PRECARIOUS WORK TO DECENT WORK)

<http://www.raiseyourhand.com/>

(WORKSAFEBC RAISE YOUR HAND MATERIALS)

<https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-regulation/part-03-rights-and-responsibilities#SectionNumber:3.23>

(WORKSAFEBC NEW AND YOUNG WORKER REGULATIONS)

<https://www.worksafebc.com/en/for-workers>

(WORKSAFEBC WORKERS' WEBSITE)

V.II. CONTACT NUMBERS

WorkSafeBC Emergency & Accident Reporting: 1-888-621-7233 (Free) or 604-276-3100

WorkSafeBC Critical Incident Response: 1-888-922-3700

WorkSafeBC Crisis Support Line: 1-800-624-2928

WorkSafeBC Prevention Information: 1-888-621-7233 (Free)

WorkSafeBC Prevention Information (Lower Mainland): 604-726-3100 (Free)

WorkSafeBC Emergency After Hours: 1-866-922-4357 (Free)

* The BC Federation of Labour and CUPE have recommended a number of changes to legislation and policy regarding working alone or in isolation.

** The BC Federation of Labour and CUPE have recommended a number of changes to legislation and policy regarding violence.

V.III. References

¹ Association of Workers' Compensation Boards of Canada

<http://awcbc.org/?s=Young+&lang=en>

² TD Special Report. "Precarious Employment In Canada: Does The Evidence Square With The Anecdotes?"

<http://www.td.com/document/PDF/economics/special/PrecariousEmployment.pdf>

³ Work organization, job insecurity, and occupational health disparities"

<http://onlinelibrary.wiley.com/doi/10.1002/ajim.22126/full>

⁴ NIOSH. WorkSafeBC. Ontario Ministry of Labour. "New and Young Workers"

https://www.labour.gov.on.ca/english/hs/sawo/pubs/fs_youngworkers.php

⁵ Canadian Centre for Occupational Health and Safety

<http://www.ccohs.gc.ca/oshanswers/legisl/vulnerable.html> ⁵ Risk Management of Young, New and Inexperienced Workers.

http://www2.enform.ca/safety_resources/companies/resourcesandtools/greenhands.aspx

⁶ The Law Commission of Ontario

<http://www.lco-cdo.org/en/our-current-projects/vulnerable-workers-and-precious-work/vulnerable-workers-interim-report-august-2012/quick-facts-about-vulnerable-workers-and-precious-work/>

⁷ Ontario's Chief Prevention Officer "New Workers Advisory 2014"

⁸ WorkSafeBC. 2010 to 2016 statistics

<https://www.worksafebc.com/en/health-safety/education-training-certification/young-new-worker/statistics>

⁹ Waiting for safety: Responses by young Canadian workers to unsafe work

<http://www.sciencedirect.com/science/article/pii/S0022437513000078> and

Institute for Work & Health

<http://www.iwh.on.ca/at-work/69/study-finds-persistence-of-higher-injury-risk-for-new-workers>

¹⁰ Medscape

<http://www.medscape.com/medline/abstract/26874687>

¹¹ Public Health Agency of Canada. Occupational injuries in Canadian youth: an analysis of 22 years of surveillance data collected from Canadian Hospitals Injury Reporting and Prevention Program.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4910461/>

¹² How Precarious Employment Affects Health and Safety at Work: The Case of Temporary Agency Workers.

<https://www.erudit.org/en/journals/ri/2011-v66-n3-ri5004266/1006345ar/>

¹³ WorkSafeBC

<https://www.worksafebc.com/en/health-safety/education-training-certification/young-new-worker/statistics>

¹⁴ University of California, Berkeley. "Working Safer or Just Working Longer? The Impact of an Aging Workforce on Occupational Injury and Illness Costs"

VI. APPENDICES

Appendix 1

3.23 Young or new worker orientation and training

An employer must ensure that before a young or new worker begins work in a workplace, the young or new worker is given health and safety orientation and training specific to that young or new worker's workplace.

The following topics must be included in the young or new worker's orientation and training:

- The name and contact information for the young or new worker's supervisor;
- The employer's and young or new worker's rights and responsibilities under the *Workers Compensation Act* and this Regulation including the reporting of unsafe conditions and the right to refuse to perform unsafe work;
- Workplace health and safety rules;
- Hazards to which the young or new worker may be exposed, including risks from robbery, assault or confrontation;
- Working alone or in isolation;
- Violence in the workplace;
- Personal protective equipment;
- Location of first aid facilities and means of summoning first aid and reporting illnesses and injuries;
- Emergency procedures;
- Instruction and demonstration of the young or new worker's work task or work process;
- The employer's health and safety program, if required under section 3.1 of this Regulation;
- WHMIS information requirements set out in Part 5, as applicable to the young or new worker's workplace;
- Contact information for the occupational health and safety committee or the worker health and safety representative, as applicable to the workplace.

[Enacted by B.C. Reg. 105/2007, effective July 26, 2007.]

3.24 Additional orientation and training

An employer must provide a young or new worker with additional orientation and training if

- Workplace observation reveals that the young or new worker is not able to perform work tasks or work processes safely, or
- Requested by the young or new worker.

[Enacted by B.C. Reg. 105/2007, effective July 26, 2007.]

Appendix 2

Five most common natures of injury by occupational domain

Occupational group	1 st	2 nd	3 rd
Food/Beverage	Open wounds 47.9	Burn / corrosion 18.4	MSK injuries 12.4
Other Service Sector	Open wounds 32.6	MSK / MSI injuries 31.8	Superficial 11.3
Delivery	Bites 28.4	MSK injures 26.4	Superficial 16.2
Arts / Recreation	MSK 34.2	Factures / dislocations 18.6	Superficial 10.1
Construction / Trades	Open wounds 38.6	MSK injuries 16.0	Superficial 10.1
Retail / Administrative	MSK injuries 23.3	Open wounds 29.7	Superficial 14.9
Primary Industry / Farming / Landscape	Open wounds 23.3	Factures / dislocations 19.8	MSK injuries 17.7
Material handlers / Vehicle Operators	MSK injuries 34.1	Superficial 21.6	Open wounds 19.7
Other Trades / Manufacturing / Processing	Open wounds 27.7	Eye injuries 19.8	MSK injuries 14.0
Childcare / Personal Support	Bites 22.8	Superficial 17.5	MSK injuries 16.7

Appendix 3

		Temp Injured	Temp Non-injured	Non-temp Injured	Non-temp Non-Injured
California	Total	51,227	203,383	2,007,337	12,551,308
Florida	Total	6,233	105,267	267,488	8,919,928
	Construction	772	7,008	3,832	239,608
	Production	312	22,718	2,536	252,904
	Transportation/Logistics	657	27,383	6,568	389,222
	Office	150	37,500	2,988	1,283,704
Massachusetts	Total	3,128	44,844	150,883	2,993,880
Minnesota	Total	3,188	43,210	102,393	2,470,801
Oregon	Total	3,545	26,275	115,787	1,505,527
	Construction	89	1,501	1,378	54,212
	Production	176	8,684	2,001	93,049
	Transportation/Logistics	184	4,068	2,862	111,288
	Office	25	6,725	831	249,489


Data from worker's compensation claims in California, Florida, Massachusetts, Minnesota and Oregon over a five-year period found that the incidence of temporary worker workplace injuries was between 36% and 72% higher than that for non-temporary workers as per ProPublica.

ProPublica stated that "This gap widened significantly for workers in certain blue-collar, more-dangerous occupations and narrowed for workers in less dangerous occupations" and "Temporary workers were 68% more likely than non-temporary workers to be working in the 20% of occupations with the highest injury rate as measured by the U.S. Bureau of Labor Statistics."

cope491
gm/hg
g:H&S_WCB_WorkSafeBC_Guides_Precarious-New-and-Young-Workers-Injury-Prevention-Guide_07-27-2018

Appendix E: Types of Hazard and Risk Assessments as well as Exposure Control Plans:

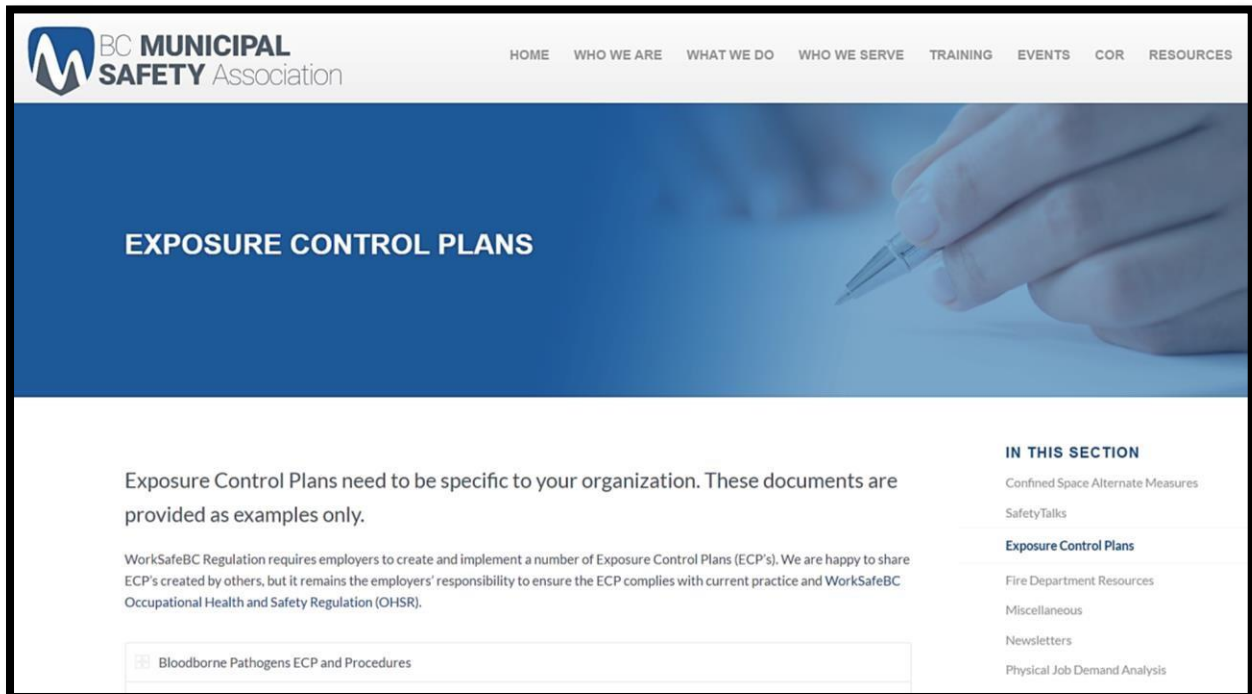
BC Centres for Disease Control. Communicable Disease Control. Blood and Body Fluid Exposure Management. See http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Epid/CD%20Manual/Chapter%201%20-%20CDC/CPS_CDManual_BBFExpManage.pdf

	Communicable Disease Control Blood and Body Fluid Exposure Management October 2017 Page 1
<hr/>	
TABLE OF CONTENTS	
1.0 INTRODUCTION.....	1
1.1 Goals.....	2
2.0 DEFINITIONS.....	3
3.0 MANAGEMENT OF A PERSON WITH A BBF EXPOSURE.....	4
3.1 Initial follow-up care	4
3.2 Risk Assessment	4
3.2.1 Risk Factors	4
3.2.2 Needlestick injuries in a healthcare setting	6
3.2.3 Consent	7
3.2.4 Assessment of source person.....	8
3.2.5 Source person is unknown.....	8
3.3 Laboratory testing.....	8
3.4 Records Processing.....	10
4.0 POST EXPOSURE TREATMENT	10
4.1 HBV.....	10
4.2 HCV	11
4.3 HIV	11
4.4 Other interventions	11
5.0 COUNSELING GUIDELINES	12
5.1 Reduce potential transmission to contacts	12
5.2 Breastfeeding.....	12
5.3 Healthcare workers.....	13
5.4 Counselling	13
APPENDIX 1: Exposed person at risk of HBV infection	14
APPENDIX 2: Exposed person at risk for HCV infection	15
APPENDIX 3: Exposed person at risk for HIV infection.....	16
APPENDIX 4: A Fact Sheet for Exposed Individuals	17

BC College of Physicians and Surgeons. Infection Prevention and Control: Exposure Control Plan for Infectious Diseases. See <https://www.cpsbc.ca/files/pdf/PPEP-AS-Exposure-Control-Plan.pdf>



BC Municipal Safety Association. See <https://www.bcmsa.ca/resources/exposure-control-plans/>



The screenshot shows the BC Municipal Safety Association website. The header includes the logo and navigation links: HOME, WHO WE ARE, WHAT WE DO, WHO WE SERVE, TRAINING, EVENTS, COR, and RESOURCES. The main heading is "EXPOSURE CONTROL PLANS". Below this, a paragraph states: "Exposure Control Plans need to be specific to your organization. These documents are provided as examples only." Another paragraph mentions: "WorkSafeBC Regulation requires employers to create and implement a number of Exposure Control Plans (ECP's). We are happy to share ECP's created by others, but it remains the employers' responsibility to ensure the ECP complies with current practice and WorkSafeBC Occupational Health and Safety Regulation (OHSR)." A list of resources is provided, including "Bloodborne Pathogens ECP and Procedures". On the right, a sidebar titled "IN THIS SECTION" lists: "Confined Space Alternate Measures", "Safety Talks", "Exposure Control Plans", "Fire Department Resources", "Miscellaneous", "Newsletters", and "Physical Job Demand Analysis".

BC MUNICIPAL SAFETY Association

HOME WHO WE ARE WHAT WE DO WHO WE SERVE TRAINING EVENTS COR RESOURCES

EXPOSURE CONTROL PLANS

Exposure Control Plans need to be specific to your organization. These documents are provided as examples only.

WorkSafeBC Regulation requires employers to create and implement a number of Exposure Control Plans (ECP's). We are happy to share ECP's created by others, but it remains the employers' responsibility to ensure the ECP complies with current practice and WorkSafeBC Occupational Health and Safety Regulation (OHSR).

- Bloodborne Pathogens ECP and Procedures

IN THIS SECTION

- Confined Space Alternate Measures
- Safety Talks
- Exposure Control Plans**
- Fire Department Resources
- Miscellaneous
- Newsletters
- Physical Job Demand Analysis

BBN. Bayesian Belief Network. Liao, Y., Xu, B., & Liu, X. (2017). A new method for assessing the risk for infectious disease outbreak. *Scientific Reports*. Retrieved February 24, 2020 from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5220355/>

[Sci Rep](#). 2017; 7: 40084.

PMCID: PMC5220355

Published online 2017 Jan 9. doi: [10.1038/srep40084](https://doi.org/10.1038/srep40084)

PMID: [28067258](https://pubmed.ncbi.nlm.nih.gov/28067258/)

A new method for assessing the risk of infectious disease outbreak

[Yilan Liao](#),^{a,1,2,*} [Bing Xu](#),^{1,3,4,*} [Jinfeng Wang](#),^{1,2} and [Xiaochi Liu](#)^{1,5}

► [Author information](#) ► [Article notes](#) ► [Copyright and License information](#) [Disclaimer](#)

This article has been [cited by](#) other articles in PMC.

Abstract

Go to: 


Over the past few years, emergent threats posed by infectious diseases and bioterrorism have become public health concerns that have increased the need for prompt disease outbreak warnings. In most of the existing disease surveillance systems, disease outbreak risk is assessed by the detection of disease outbreaks. However, this is a retrospective approach that impacts the timeliness of the warning. Some disease surveillance systems can predict the probabilities of infectious disease outbreaks in advance by determining the relationship between a disease outbreak and the risk factors. However, this process depends on the availability of risk factor data. In this article, we propose a Bayesian belief network (BBN) method to assess disease outbreak risks at different spatial scales based on cases or virus detection rates. Our experimental results show that this method is more accurate than traditional methods and can make uncertainty estimates, even when some data are unavailable.

With the appearance of a variety of new infectious diseases (e.g., H7N9, H5N1, and Ebola) and the renewed prevalence of existing diseases (e.g., dengue fever; hand, foot, and mouth disease;

measles and hepatitis A virus), the outbreak and prevalence of infectious diseases have

CUPE BC Region. Power Point “Introduction to Occupational Health and Safety and Joint Health and Safety Committees (“JHSCs”) Version 3 Winter 2020. This includes extensive references to hazard and risk assessments. See


<https://www.cupe.bc.ca/committee/occupational-health-and-safety-committee/>



Introduction to Occupational Health and Safety and Joint Health and Safety Committees (“JHSCs”)
Version 5 – Summer 2020

Tom McKenna, National Health and Safety Representative

The information is not legal advice. The materials only address Workers Compensation and Occupational Health and Safety. Nothing in this presentation supersedes the WCB Act, OHS Regulations and Policy. There may also be Collective Agreement rights and obligations. This information is for CUPE use only, cannot be used in any other proceeding and is without prejudice and precedent to any labour relations matter, collective bargaining, grievance, arbitration, and WCB claim or appeal. Each case is subject to the fact pattern and to the changing jurisprudence. This information is subject to frequent changes in law, regulation and policy and will vary by both province and jurisdiction. The current law and policy should be reviewed as they change frequently. There were many changes to numbering in the BC Workers Compensation Act in 2020.



1

WorkSafeBC Sample Exposure Control Plan for Biological Agents for Occupational First Aid Attendants. See <https://www.worksafebc.com/en/resources/health-safety/exposure-control-plans/exposure-control-plan-for-infectious-disease-for-occupational-first-aid-attendants?lang=en>

The screenshot shows the WorkSafeBC website interface. At the top, there is a navigation bar with the WorkSafeBC logo, links for 'Forms & Resources', 'Law & Policy', 'About Us', and 'Contact Us', and a 'Log in / Create an account' button. Below this is a secondary navigation bar with links for 'Health & Safety', 'Insurance', 'Claims', and 'I Am a...'. A search bar is also present. The main content area features the title 'Sample Exposure Control Plan for Biological Agents for Occupational First Aid Attendants (OFAAs)'. To the left of the text is a thumbnail image of the PDF document. The text describes the purpose of the plan: 'This exposure control plan is for employers with workers who may be exposed to biological agents, like blood-borne pathogens or other infectious materials. The purpose of the plan is to eliminate or minimize the risk of infection should exposure occur. Employers can use this resource to help develop a plan that suits their workplaces.' To the right of the text is a 'Download PDF' button. Below this, the page provides metadata: 'Publication Date: Nov 2019', 'File type: PDF (71 KB)', and 'Asset type: Exposure Control Plan'. At the bottom, there are social sharing options, including 'Share via Email (Anonymously)' and icons for Facebook, Twitter, LinkedIn, YouTube, and Instagram.

WorkSafeBC. Controlling Exposure: Protecting Workers from Infectious Disease.
See <https://www.worksafebc.com/en/resources/health-safety/books-guides/controlling-exposure-protecting-workers-from-infectious-disease?lang=en>

WORK SAFE BC

Forms & ResourcesLaw & PolicyAbout UsContact UsLog in / Create an account

Health & SafetyInsuranceClaimsI Am a...

Controlling Exposure: Protecting Workers from Infectious Disease



This book describes common infectious diseases, how they are spread and explains how to protect workers.

[Download PDF](#)

Publication Date: Mar 2009

File type: PDF (2 MB)

Asset type: Book

Order: BK129

Available from the WorkSafeBC Store

Share via Email (Anonymously)

[f](#) [t](#) [in](#) [re](#) [v](#) [m](#) [e](#)

Appendix F: Heat Related Impacts on Workers:³⁸⁶

Table 3	
Health Impacts of Urban Heat Island (UHI) on Outdoor Workers.	
Health Impacts	Author & Year
Heat exposure	
• Heat Stress/Stroke	Leal Filho et al. [48]
• Fatigue	Ward et al. [43]
• Dehydration and Kidney Disease	Kjellstrom et al. [40]
• Cardiovascular Disease	Heaviside et al. [31]
• Respiratory Distress	Hanna et al. [42]
• Death	Tan et al. [57]
• Increase morbidity and fatality	Kovats and Hajat, [56]
Air Pollution	
• Respiratory Distress	
• Respiratory Track Irritation	Kjellstrom et al. [40]
• Asthma Attack	Ward et al. [43]
• Increased Respiration due to Heat exposure	Kjellstrom et al. [52]
• Exposure to carcinogens	

³⁸⁶ Moda, H., Filho, W.L., & Minhas, A. (2019). Impacts of Climate Change on Outdoor Workers and Their Safety: Some Research Priorities. *International Journal of Environmental Research and Public Health*. 2019 September 16. Retrieved February 24, 2020 from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6765781/>

Unbalanced Physiological Function leading to decrease in work capacity	Lucas et al. [29] Lundgren et al. [24] Kjellstrom et al. [40] Kovats and Hajat, [56]
Extreme weather and sea level rise <ul style="list-style-type: none"> • High risk of flooding causing displacement • Injury • Resource disruption e.g., water supply 	Kjellstrom et al. [52] McGranahan et al. [58]
Psychological effects on Workers Mental health	Kjellstrom et al. [7] Lundgren et al. [24] Hanna et al. [42] Kjellstrom et al. [52]

Appendix G: Potential Impact of Climate Change on Occupational Sectors by Exposure Source:³⁸⁷

Potential impact of climate change on occupational sectors by exposure source.				
Contaminant Type	Occupation at Risk	Exposure Route	Health Effect	Reason for Likely Increase
Pesticides	Agriculture, landscape	Dermal, inhalation, ingestion	Numerous: carcinogenic, Asthma, COPD, cardiopulmonary etc.	Increase in plant disease
Veterinary medicines	Veterinary, agriculture	Dermal, ingestion	Antimicrobial resistance	Increased temperature
Ozone	Construction, transportation, energy, agriculture, traffic warden, oil and gas etc.	Inhalation	Asthma, COPD, cardiopulmonary	Increased temperature
PAHs	Construction, transportation, energy, agriculture, traffic warden, oil and gas, firefighting etc.	Inhalation	Cardiopulmonary, carcinogenic	Increased dust, forest fires
Pathogenic microorganism	Fishing, agriculture, sanitation, most outdoor work	Dermal, Inhalation, ingestion	Infectious disease	Increased flooding, soil and water contamination
Vector-borne infectious agents	Food-animal production, most outdoor work	Dermal	Infectious disease	Increased range of vectors
Soil dust	Agriculture, construction, most outdoor work	Inhalation, ingestion	Silicosis, cardiopulmonary	Drier conditions
Industrial processing chemicals	Chemical manufacture, emergency response operations	Dermal, Inhalation, ingestion	Numerous: Carcinogenic, Asthma, COPD, cardiopulmonary etc.	Flood, wildfires
Wildfire smoke	Firefighting, agriculture,	Inhalation	Respiratory	Drier conditions
Exposure to extreme condition (temperature and humidity)	Firefighting, oil and gas workers, and all outdoor workers exposed to direct sun,	Dermal, Inhalation, Ingestion	Heat exhaustion, heat stroke, chronic kidney disease, chemical poisoning, injury	Extreme condition
Other indirect climate-related hazards	Low-income groups with limited health protection; workers with existing non-climate health problems affected by heat	Dermal, inhalation,	Infectious diseases, non-communicable diseases, mental health issues, etc.	Others

Adapted and modified from Applebaum et al. [20] and Kjellstrom et al. [36].

³⁸⁷ Moda, H., Filho, W.L., & Minhas, A. (2019). Impacts of Climate Change on Outdoor Workers and Their Safety: Some Research Priorities. *International Journal of Environmental Research and Public Health*. 2019 September 16. Retrieved February 24, 2020 from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6765781/>

Appendix H: Hazards versus Risks – Contrasts and Comparisons:

Hazard and risk assessment and management occur as part of the due diligence requirement for Employers and the precautionary principle should be applied to both.

Due diligence is taking all care and precautions, reasonable in the circumstances, to protect workers and employees (there is a legal difference). It requires Employers to identify all workplace hazards, implement all necessary preventive measures and communicate appropriately to all workers, employees, contractors, sub-contractors, etc. at all sites under the Employer's direct and indirect control.

The precautionary principle means taking action to prevent hazards and risks without having to wait for scientific proof or certainty that a course of action is necessary.

A hazard is any source of potential damage, harm or adverse health effects on something or a person(s) – directly, indirectly, cumulatively, immediately or potentially, and additively. As per the CSA Group and CCOHS, this can include the following (non-exhaustive list of categories):

- **Biological:** Pathogens - Bacteria, viruses, parasites, algae, prions, insects, arachnids, plants, moulds, birds, animals, humans, etc.
- **Chemical:** Chemicals, toxins, noxious substances, volatile organic compounds, ozone, etc. whether in gaseous, liquid, solid or any other form. This includes air quality.
- **Ergonomic:** Anything that leads to musculoskeletal or repetitive strain injuries, etc.
- **Physical:** Physical injury, poisons, toxins (note that the physical category can overlap with other categories such as ergonomic and chemical), radiation including solar / UV radiation, temperature extremes, humidity extremes, magnetic fields, pressure extremes, noise, etc.
- **Psychosocial:** Mental health injuries, violence (in any form including bullying and harassment, domestic violence, physical violence, threats, etc.), etc.

- Safety: Slipping and tripping hazards, inappropriate machine guarding, equipment malfunctions or breakdowns, lack of personal protective equipment, lack of policies and procedures, other workers, etc. There are hundreds of examples.

Hazard *identification* is the process of finding, listing and characterizing these hazards.

Risk is the chance or probability of harm or an adverse effect, including health effects, if exposed to a hazard. It can apply to a person(s) or something such as equipment. There are many factors that influence the degree of risk. These factors include how exposure to a hazard occurs, the nature of the hazard and the nature and extent (duration) of the exposure, for example.

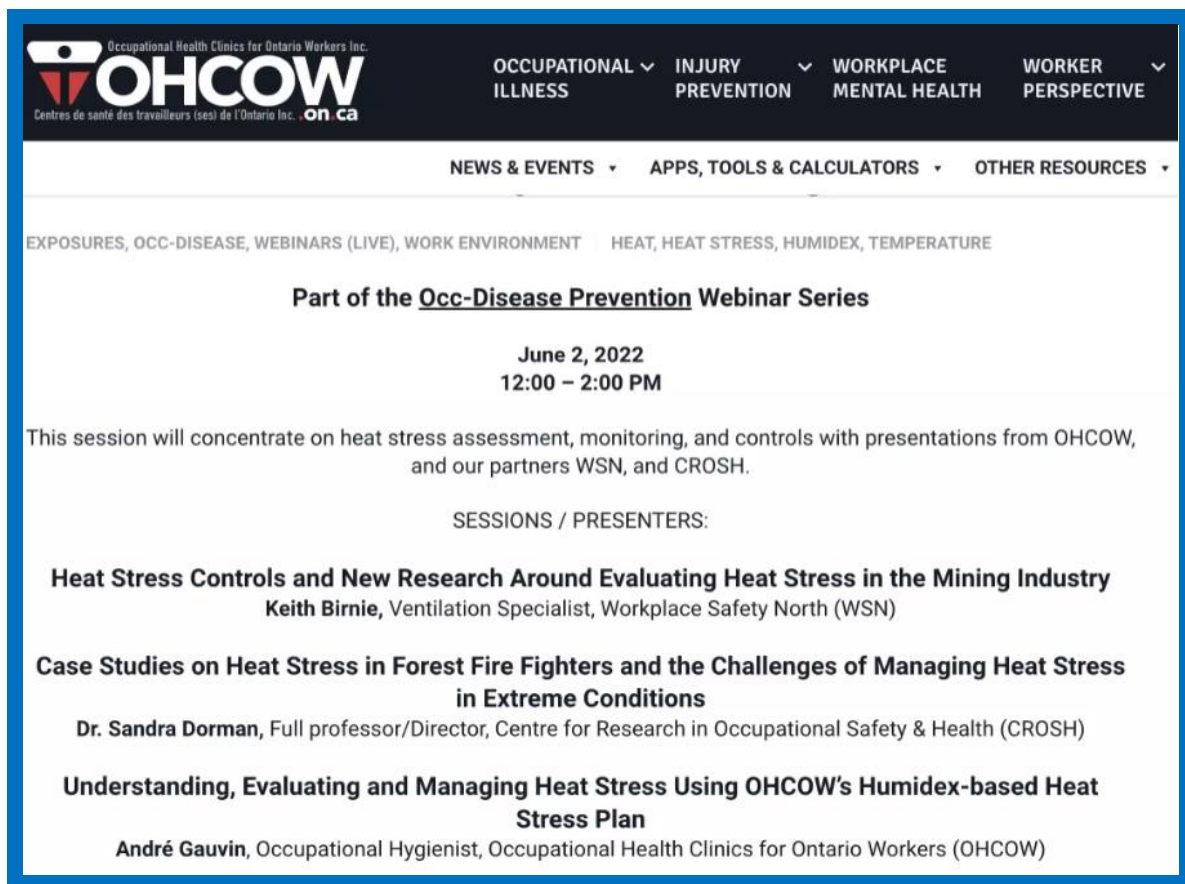
Risk *assessment* considers the identification of hazards and the analysis and evaluation of the risk. It includes:

- Identify hazards and risk factors that have the potential to cause harm (hazard identification).
- Analyze and evaluate the risk associated with that hazard (risk analysis and risk evaluation).
- Determine methods to eliminate the hazard or control the risk when the hazard cannot be eliminated (risk control using the hierarchy of control with elimination being the primary goal).

Appendix I: Select Slides – OHCOW – Heat Stress – June 2022:

This presentation is included as heat is the number one climate impact for workers. Key slides are bordered in **red**. Also see: CROSH - Centre for Research in Occupational Safety and Health - Guide to Thermal Stress, OHCOW - Humidex Based Heat Response Plan Matrices, OHCOW - Heat Stress Awareness Guide, and OHCOW – Heat Stress Awareness Tool at:

<https://www.ohcow.on.ca/injury-prevention/work-environment/heat-cold-extremes/> and <https://www.ohcow.on.ca/posts/heat-stress-awareness-guide/>



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OHCOW
Centres de santé des travailleurs (ses) de l'Ontario Inc. on.ca

OCCUPATIONAL ILLNESS INJURY PREVENTION WORKPLACE MENTAL HEALTH WORKER PERSPECTIVE

NEWS & EVENTS APPS, TOOLS & CALCULATORS OTHER RESOURCES

EXPOSURES, OCC-DISEASE, WEBINARS (LIVE), WORK ENVIRONMENT HEAT, HEAT STRESS, HUMIDEX, TEMPERATURE

Part of the Occ-Disease Prevention Webinar Series

June 2, 2022
12:00 – 2:00 PM

This session will concentrate on heat stress assessment, monitoring, and controls with presentations from OHCOW, and our partners WSN, and CROSH.

SESSIONS / PRESENTERS:

Heat Stress Controls and New Research Around Evaluating Heat Stress in the Mining Industry
Keith Birnie, Ventilation Specialist, Workplace Safety North (WSN)

Case Studies on Heat Stress in Forest Fire Fighters and the Challenges of Managing Heat Stress in Extreme Conditions
Dr. Sandra Dorman, Full professor/Director, Centre for Research in Occupational Safety & Health (CROSH)

Understanding, Evaluating and Managing Heat Stress Using OHCOW's Humidex-based Heat Stress Plan
André Gauvin, Occupational Hygienist, Occupational Health Clinics for Ontario Workers (OHCOW)

Heat stress events, such as heat exhaustion and heat stroke, can have long term (years) effects on health. It is NOT a one time event. A person who has had heat exhaustion or heat stroke may be at higher risk for susceptibility for future heat exhaustion and heat stroke.

- André Gauvin – Occupational Hygienist
 - Occupational Health Clinics for Ontario Workers (OHCOW)
 - Overview of physiological responses to heat and current heat stress management guidelines
- Keith Birnie – Industrial Hygienist/Ventilation Specialist
 - Workplace Safety North (WSN)
 - Covering heat stress controls, New research surrounding heat stress
- Dr. Sandra Dorman – Full Professor and Director
 - Centre for Research in Occupational Safety and Health (CROSH)
 - Challenges of managing heat stress in extreme conditions

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Regulating Temperature

- **Thermoregulation**
 - Despite variations in temperatures, humans can maintain a constant body temperature by balancing heat gain with heat loss.
- Humans can tolerate a decline in core temperature of 10°C but ONLY an increase of 5°C.

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Heat Loss

Thermoregulation In Heat Stress



- The body has thermoregulatory mechanisms that primarily protect against overheating.
- Four Physical Processes Contribute to Heat Loss:
 - Radiation **60%**
 - Conduction **3%**
 - Convection **12%**
 - Evaporation **25%**



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Heat Loss in High Humidity

- Evaporation of Sweat is Key!
- Three factors affect evaporative cooling
 1. Surface Exposure;
 2. Temperature and Relative Humidity of Air;
 3. Convective air currents around the Body.



Relative Humidity ratio of water in ambient air at a particular temperature to the total quantity of moisture that air could contain (%)



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Factors Determining Physiological Strain

- Air temperature and relative humidity;
- Individual differences in body size and fatness;
- State of Training;
- Degree of Acclimatization;
- Environmental influences such as convective air current and radiant heat gain;
- Intensity of Activity;
- Amount, type, and color of clothing.

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Heat Strain Self Evaluation

- Heart beat measurement (sustained 180bpm – age)
- Body temperature (38°C)
- Recovery heart rate @ 1 min. more than 120 bpm
- Symptoms of sudden and sever fatigue, nausea, dizziness, or lightheadedness

Worker may be at risk If

- ✓ Profuse sweating sustained over hrs
- ✓ Weight loss in a shift more than 1.5 %
- ✓ Noticing less frequent urination



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Working In the HEAT

- **Physiological Effects**

- **Blood Flow**

- Other tissues compromise blood flow

- **Fluid Loss**

- Evaporative cooling
 - Decreased blood volume

- **Core temperature rise**

- Hot environment + Working muscles
 - Core temperature rise causes impaired functioning of brain and fatigue.

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Blood Flow in the Heat

- **Circulatory Dilemma**

- The body faces two demands when working in the heat:

1. Muscles require delivery of oxygen through the blood
2. Blood is diverted to the periphery to transport heat for cooling at the skin surface (oxygen is not delivered)

- **DANGER**

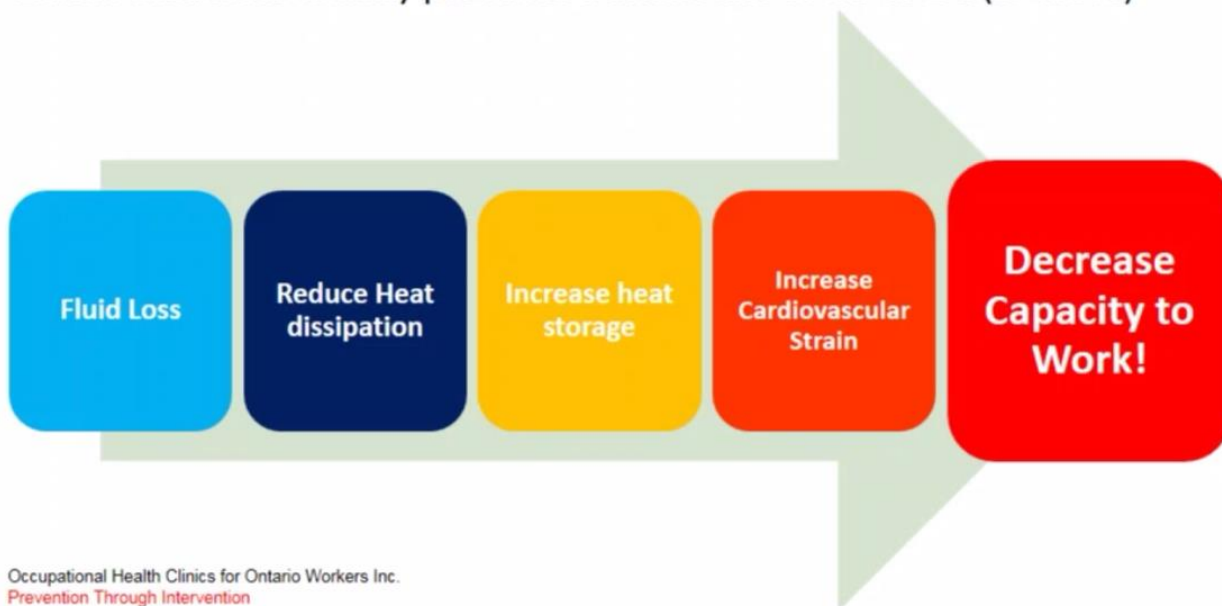
- When it comes to exercise/work the body will favour oxygen delivery to the working muscles over cooling mechanisms

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Fluid Loss in the Heat

- Dehydration = body water loss
- 1 hour moderate activity produces a sweat loss of 0.5 to 1 L (or more)



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Hydration Strategies

- Hyperhydration – ingesting ‘extra’ water before work in the heat offers thermoregulatory protection.
- Strategy:
 1. 500 mL night before working in heat
 2. Another 500 mL upon awakening
 3. An additional 400 to 600 mL 20 minutes prior to activity.
 4. Consistent fluid intake throughout the day.



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Signs of Hydration

- Inadequate Hydration
 - Infrequent urination
 - Excessive weight loss
 - Strong odour of urine
 - Urine **Colour**
- Adequate Hydration
 - Frequent urination
 - Urine **Colour**
 - Odourless



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Heat Acclimatization

Body will adapt to hot environments over time in several ways including:

1. Improved cutaneous blood flow;
2. Effective distribution of Cardiac Output;
3. Lowered threshold for and increased sweating;
4. More effective distribution of sweat over skin;
5. Lowered salt concentration of sweat;
6. Lowered heart rate for similar activity level.



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Heat Acclimatization (2)

- Can take up to 4-7 days to fully acclimatize. ACGIH 2022 TLV suggests: **exposed at least 2 hours of heat stress exposure for 5 of last 7 days or 10 of last 14 days**
- Noticeable decline after 4 days, and can be completely lost with removal from heat for ~2-3 weeks (i.e. need to re-acclimatize following lengthy vacations).

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After 4 days of being out of a hot environment most of the heat acclimatization is gone.



Those at Higher Risk

- Lack of physical activity
- Poor physical condition
- Overweight
- Age
- Very small body size
- Dehydration
- Excessive clothing
- High alcohol, caffeine, nicotine intake



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Heart rate increases in heat by up to 8 beats per degree even if a person is at rest and not working.



Occupations at risk

- Involving high air temperatures, radiant heat sources, high humidity, or strenuous physical activities:

- Construction workers or outdoor workers
- Iron and steel foundries
- Underground workers
- Brick firing and ceramic plants
- Firefighters
- Bakeries
- Smelter workers



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Heat Illness

Disabling complications relating to the body's inability to cope with heat:

- Heat Rash
- Heat Cramps
- Heat Exhaustion / Stress / Fainting
- Heat Stroke

Statistics

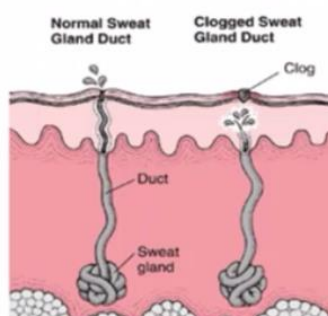
- Heat waves claim more lives each year than all other weather-related exposures combined (hurricanes, tornadoes, floods, and earthquakes).
- According to the CDC, between 1979-2003 8,015 deaths were attributed to excessive heat exposure (average of approximately 334 deaths per year).

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Heat Rash

- Heat Rash is an irritation of the skin caused by excessive heat and sweating
- Rash develops as a result of plugged sweat glands (enhanced by hot, humid environment)
- Red, bumpy rash with severe itching.



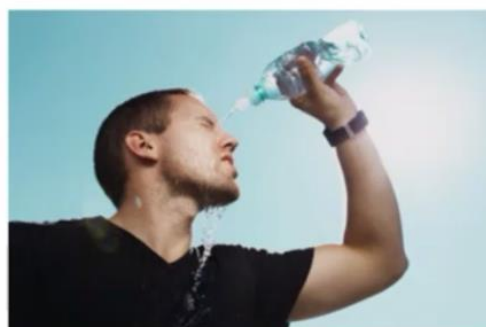
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<https://www.merckmanuals.com/home/skin-disorders/sweating-disorders/prickly-heat>



Heat Rash - Treatment

- Change into dry clothes and avoid hot environments
- Rinse skin with cool water



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Heat Syncope

- Usually occurs in unacclimatized and dehydrated workers during the first heat wave
- Early warning sign of excessive heat strain
- Symptoms include:
 - Fainting (Short duration)
 - Dizziness
 - Light-headedness from standing too long or suddenly rising from a sitting or lying position
- Treatment
 - Sit or lie down in a cool place.
 - Slowly drink water, clear juice, or a sports drink.

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Heat Cramps

- Heat Cramps occur during or after physical activity in a hot environment, usually in the specifically exercising muscles.
 - Core temperature often remains normal
 - Heavy perspiration
 - Muscle Cramps (legs, arms, abdomen)
 - Weak/Lightheaded
- Typically caused by an imbalance in the body's fluid level and electrolyte concentrations.
- Heat cramps may also be a symptom of heat exhaustion.

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Heat Cramps Prevention

- Rest briefly
- Drink electrolyte-containing drinks (e.g. sports drink) instead of plain water (to prevent water intoxication, or low blood Na level)
- Seek medical help if cramps persist.

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Heat Exhaustion



- Heat Exhaustion usually develops in unacclimatized workers during the first heat wave.
- Caused by loss of a large amount of fluids & electrolytes and ineffective circulatory adjustments .
- **Warning signs of heat exhaustion:**
 - Heavy sweating
 - Paleness
 - Muscle cramps
 - Tiredness / Weakness
 - Dizziness
 - Headache
 - Very Thirsty
 - Nausea or vomiting
 - Fainting



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Heat Exhaustion - Treatment

- Move to cool area, loosen clothing; make person lie down; offer sips of cool water.
- It takes at least 30 minutes to cool the body down after overheating
- Get medical attention
- CPR (in cases of cardiac arrest)

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Heat Stroke

- Heat stroke is the most serious and complex of the heat stress illnesses.
- Reflects failure of heat-regulating mechanisms from an excessively high core temperature.
- Classic form:
 - Core temp. > 105 F / 40 C
 - Absence of sweating
 - Altered mental status

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Heat Stroke

Exertional heat stroke

- Usually occurs in individuals (workers) who engage in:
 - strenuous physical activity for a prolonged period of time in a hot and humid environment.
 - and often have impeded heat dissipation.

Non-exertional heatstroke (NEHS)

- more commonly affects sedentary elderly individuals, persons who are chronically ill, and very young persons.
- NEHS usually occurs during environmental heat waves and is more common in areas that have not experienced a heat wave in many years.

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Heat Stroke Progression

- Body no longer able to cool itself
- Basic heat loss mechanisms no longer functioning:
 - High body temperature (may be $> 40^{\circ}\text{C}$)
 - Starting with excessive sweating \rightarrow No sweating
 - Hot, dry skin
 - Headache, dizziness, nausea
 - Rapid heart beat, rapid and shallow breathing
 - Confusion, irritability
 - Loss of consciousness
 - Seizures
 - Can lead to death

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Heat Stroke - treatment

- Immediate medical attention.
 - Call 911
- Immediate & aggressive cooling (by fanning, removing clothes, spraying with cool water, etc).
- Do not encourage eating
- Give fluid (in small amounts)
- Have the victim lie down with feet elevated, apply cool compresses

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ACGIH Heat Stress and Heat Strain TLV®:

- **Threshold limit value (TLV)** applies to “nearly all heat acclimatized, adequately hydrated, unmedicated, healthy workers who are repeatedly exposed without adverse health effects.”
- Based on preventing workers' core temperatures from rising above 38°C.
- Developed a method for assessing heat stress based on a **wet-bulb globe temperature (WBGT) threshold**.

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What is a WBGT?

- WBGT (°C) measures the environmental contribution to heat stress including
 - air temperature (Normal temperature)
 - radiant heat (Globe temperature)
 - Humidity (Natural wet bulb and normal temperature)



2 Ways to calculate

With solar load

$$\text{WBGT} = 0.7\text{NWB} + 0.2\text{GT} + 0.1\text{DB}$$

Without solar load

$$\text{WBGT} = 0.7\text{NWB} + 0.3\text{GT}$$

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ACGIH: TLV and Action Limit for Heat Stress Exposure (WBGT in °C)



Allocation of work in a cycle of work/recovery	light	moderate	heavy	very heavy
75% to 100% work (breaks incl.)	31.0 28.0	28.0 25.0	-- --	-- --
50% to 75% work	31.0 28.5	29.0 26.0	27.5 24.0	-- --
25% to 50% work	32.0 29.5	30.0 27.0	29.0 25.5	28.0 24.5
0% to 25% work	32.5 30.0	31.5 29.0	30.5 28.0	30.0 27.0

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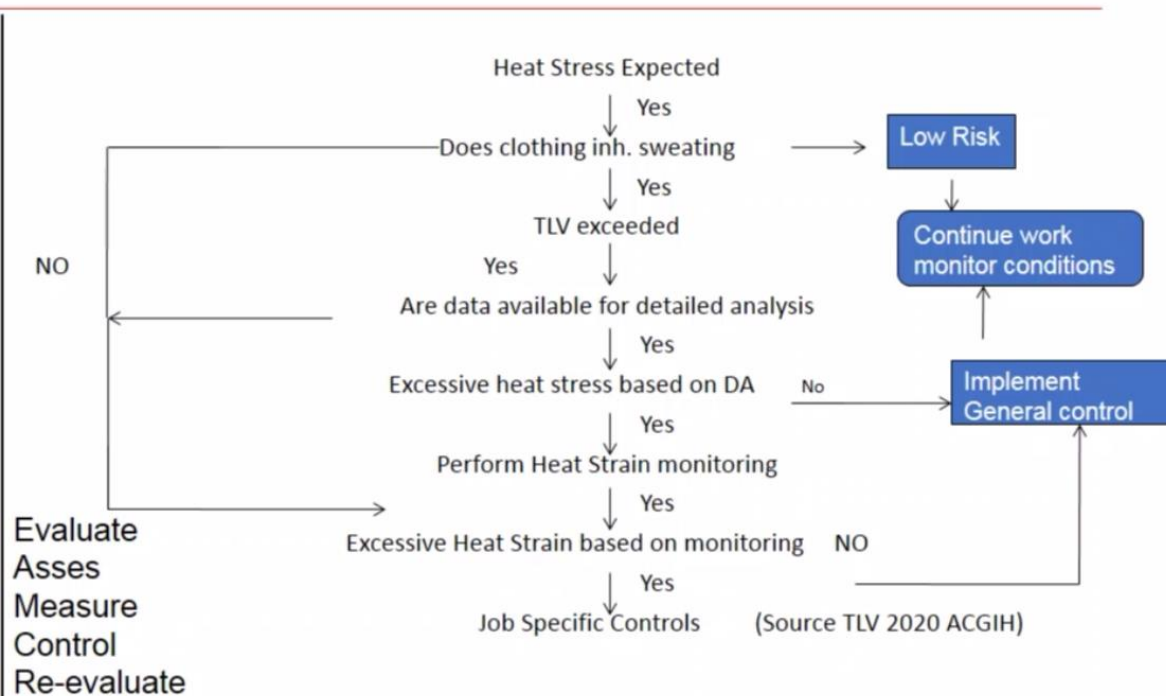
TLV (in °C)



Action Limit (in °C)



Heat Stress Evaluation



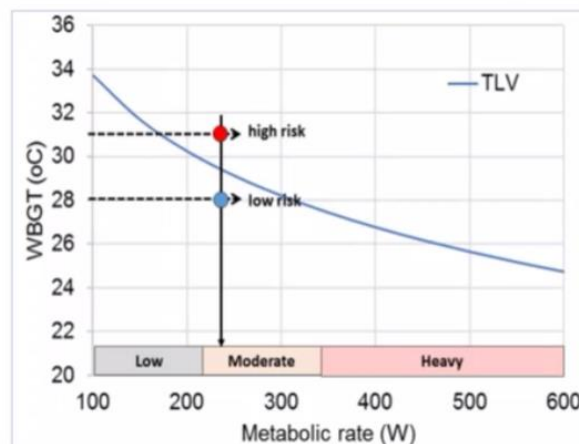
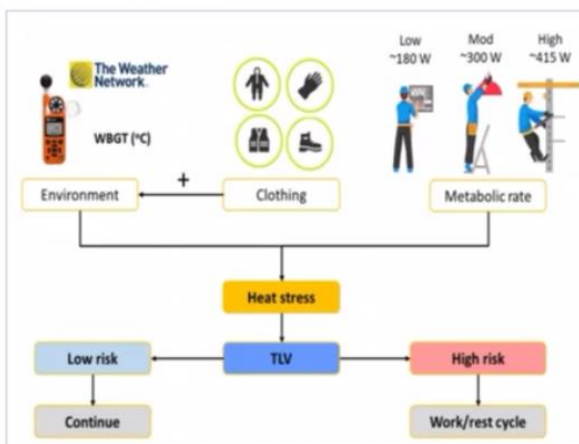
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Existing approach for managing heat stress in workers: The ACGIH TLVs

Approach extends upon the simple use of environmental parameters to consider clothing and work intensity.

The prescribed work-rest allocations are based on environmental conditions (WBGT) and estimated work intensity (with adjustments for clothing worn) with the primary goal of maintaining body core temperature within safe limits ($\leq 38^{\circ}\text{C}$; 100.4°F).



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What is Humidex?

Humidex is a Canadian invention to combine temperature and relative humidity into a single number so people can tell how hot it “feels”, for example:

26°C	@ 40% RH	=>	28°C Humidex
	@ 60% RH	=>	32°C Humidex
	@ 80% RH	=>	36°C Humidex
	@ 100% RH	=>	39°C Humidex

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June 2017

Humidex Heat Stress Response Plan

Limitations: this table is based on work with **little or no radiant heat**, assuming wearing **regular summer clothing**; if your specific working conditions vary from these assumptions, see the steps 1-5 listed below to make adjustments

Temp (in °C)	Relative Humidity (in %)																									
	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	15%	10%							
49																			50							
48	NEVER IGNORE ANYONE'S SYMPTOMS DESPITE YOUR MEASUREMENTS!!!																									49
47	Moderate Unacclimatized & Heavy Acclimatized							Moderate Acclimatized & Light Unacclimatized											50	47						
46																			49	46						
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Ex: Temperature – 29°C

Relative Humidity – 65%

Humidex Heat Stress Plan:



Humidex 1	Response	Humidex 2
25 – 29	supply water to workers on an “as needed” basis	32 – 35
30 – 33	post Heat Stress Alert notice; encourage workers to drink extra water; start recording hourly temperature and relative humidity	36 – 39
34 – 37	post Heat Stress Warning notice; notify workers that they need to drink extra water; ensure workers are trained to recognize symptoms	40 – 42
38 – 39	work with 15 minutes relief per hour can continue; provide adequate cool (10-15°C) water; at least 1 cup (240 mL) of water every 20 minutes worker with symptoms should seek medical attention	43 – 44
40 – 41	work with 30 minutes relief per hour can continue in addition to the provisions listed previously;	45 – 46*
42 – 44	if feasible, work with 45 minutes relief per hour can continue in addition to the provisions listed above.	47 – 49*
45 or over	only medically supervised work can continue	50* or over

Humidex calculator: http://www.ohcow.on.ca/edit/files/general_handouts/heat-stress-calculator.html

* at Humidex exposures above 45, heat stress should be managed as per the ACGIH TLV®

1

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Adjustment for Clothing

- Clothing can limit sweat evaporation which causes the body to heat up.
- Results from less air flow between the clothing and skin making sweat evaporation difficult
- TLV (WBGT) is based on wearing long-sleeve cotton shirt and pants.
- When clothing hinders evaporation, value needs to be added to measured temperature, which is based on WBGT.



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Clothing adjustment factors



	Current CAV	NIC 2022	Humidex response plan
Clothing Type	Addition to WBGT °C	Changes to WBGT °C	Changes in humidex °C
Short Sleeves and Pants of Woven Material		-1.0	
Work clothes (long sleeve shirt and pants)	0	0	0
Cloth (woven material) coveralls	0	0	0
Double-layer woven clothing	3	3	5
SMS polypropylene coveralls	0.5	0.5	1
Polyolefin coveralls	1	1	2
Limited-use vapor barrier coveralls	11	11	Monitor vital signs
Limited-use vapor barrier coveralls with hood (Full Head and Neck Covering; not face)		+1	
Negative Pressure Respirator (Full Face or Less)		+0	



Protective face masks and Thermoregulation

Protective Face Masks (N95, Air purifying respirators, Surgical masks)

- Negatively impacts respiratory and dermal mechanisms of human thermoregulation (relatively minor increases)
 - impairment of
 - convection,
 - evaporation
 - radiation processes.

Raymond et al. (2011), Protective Facemask Impact on Human Thermoregulation: An Overview.

Fletcher et al (Fletcher et al. 2014) looked directly for a Clothing Adjustment Value (CAV) for a full-face negative pressure respirator while wearing a vapor barrier ensemble with hood. They reported a small non-significant difference. For this reason, respirators and other face coverings are assigned a CAV = 0.

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Adjustment for Radiant Heat (add to Humidex):



- If working outdoors in direct sunlight between 10 am-4pm, add 2-3°C to Humidex.
- If working indoors with radiant heat sources, use common sense to add 2-3°C (compare it to amount received from sun).



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Heat Stress Prevention Guidelines

•Summary

- It important to have a heat stress plan in place when working in the heat
- Once the risk assessment is complete, controls should be in place to prevent heat related illness.

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Hot Worksites and Health: The Risky Business of Working in the Heat.

Heat Stress Controls

June 2, 2022

1 888 730 7821 (Toll free Ontario)
workplacesafetynorth.ca



Heat Stress Controls

Once the risk for heat stress has been assessed, controls should be put into place to prevent heat-related illness.

Controls for heat stress prevention and management generally fall into 3 categories:

1. Engineering Controls
2. Administrative Controls
3. Personal Protective Equipment (PPE)



2

Engineering Controls

– *reducing heat at source (eliminate if possible)*

- Controlling heat at source (e.g. insulation, blinds on windows, exhaust hot air or steam, radiant shielding).
- Ventilation (general and local)
- General and local air conditioning
- Air-conditioned rest areas & cooling booths for breaks.
- Utilize cooling fans if temperature is $<35^{\circ}\text{C}$.
- Actively cool body with misters.
- Use less labor-intensive tools (e.g. mechanical aids, mechanization)

Particularly, when cooling work environment is difficult



Administrative Controls

*Minimize worker exposure &
Increase time for recovery*

- Have an established and enforced heat stress policy.
- Controlling internal heat generation:
 - reduce workload, pace, and duration
 - increase the frequency rest breaks (or have workers perform lighter duties in cool areas)
 - establish and follow work-rest regimes
 - assign extra workers
 - schedule strenuous jobs to cooler times of day
 - ensure good nutrition and rest (fruits and vegetables)
- Ensure proper acclimatization of workers.



Administrative Controls

- Train workers to recognize early signs and symptoms of heat stress.
- Provide accessible drinking water (encourage workers to drink cool water every 15-20 minutes (even if not thirsty)).
- Self monitoring and co-worker observation (buddy system).
- Develop a hot-weather plan (such as the Humidex, ACGIH, etc.).



Personal Protective Equipment

- If appropriate, light summer or breathable clothing should be worn.
- In case of high radiant heat, reflective clothing may help.
- Cooling vests and water-cooled garments.
- For very hot environments, air, water or ice-cooled insulated clothing should be considered.



Protective Clothing and Heat Stress

- Protective clothing can inhibit the sweat evaporation due to lack of permeation. This could increase the body internal temperature and thus cause heat strain.
- Vapor barrier clothing can also increase heat stress on the body.
- Extra caution should be taken in performing heat stress evaluation.
- Remove protective clothing during breaks to improve sweat evaporation and reduce body temperature.
- Passive or active cooling during rest and replenish fluids in the body. 💧



Heat Stress Control Guidance

- **Acclimatization**
 - Acclimate new and returning workers to hot environments and gradually increase workload.
 - Can take up to 2-3 days for returning employees to re-acclimatize and up to 14 days for new employees to be fully acclimatized.
 - Can be lost quickly
- **Buddy system**
 - Assess each other's symptoms for heat related illness
- **Face coverings**
 - Provide face coverings that are lightweight and light in colour
 - Consider more frequent rest breaks to account for additional heat stress of wearing a face covering



Heat Stress Control Guidance

- **Ventilation**
 - Make sure indoor facilities are well ventilated
 - In non-climate controlled facilities, increase outdoor air circulation as much as possible to promote evaporation of sweat
- **Medical Screening/Monitoring Program**
 - Pre-placement and periodic medical examinations may be required to those routinely exposed to high levels of heat (with medical conditions).
 - Workers can self monitor body weight, urine frequency/duration and color as indicators of possible dehydration.



It takes up to 3 days to recover from heat illnesses.

IMPORTANT

Never ignore anyone's signs or symptoms, no matter what the temperature or humidex!

Ignoring signs and symptoms in the early stages will result in progressively increased danger.



What to do for Heat-Related Illness

Call 911 (if Required)

While waiting for help to arrive you should do the following:

- Move worker to a cool shaded place
- Loosen or remove heavy clothing
- Provide cool water / sports drink to worker
- Fan and mist worker with water



Heat Stress Management Policy/Program

Heat Stress Management Policy/Program:

- Risk Assessment (e.g. what factors contribute to heat illnesses)
- Exposure Guidelines and Industrial Hygiene Monitoring
- Controls (Engineering, Administrative, PPE)
- Medical Screening and Surveillance Program
- First aid and procedures for getting medical attention
- Liquid replacement and cool rest areas.
- Heat acclimatization program
- Scheduling of work and work/rest schedules
- Roles and responsibilities for the program
- Training (e.g. responsibilities, causes, signs/symptoms, first aid, predisposing factors, etc.)




Summary

- Prevention is the best form of treatment.
- Learn the signs and symptoms of heat-related illness.
- Monitor yourself and your coworkers (buddy system).
- Block out direct sun or other heat sources
- Use cooling fans/air-conditioning and rest regularly
- Drink lots of water
- Wear lightweight, light coloured and loose-fitting clothing
- Avoid drinking alcohol and caffeinated drinks
- Implement a Heat Stress Prevention Program






Slides from Dr. Dorman are not included below as they pertained to mining and are part of an ongoing research project. One exception is below.



Implications



Current ACGIH standards cannot protect workers because:

- Some work cannot have time limits;
- Some work conditions fluctuate rapidly;
- Different workers respond differently to the same conditions;
- The same worker can respond differently, on different days, to the same conditions;
- Climate change is impacting more workplaces & workers; who currently don't enforce guidelines or who create their own.

Heat stress protection must be rapid, preventative and not rely on external monitoring systems.

What to Monitor?

According to the ACGIH (2017), heat stress can be defined by the following conditions:

- *Core Body Temperature over 38.5°C for acclimatized and medically selected individuals; or*
- *38°C for unacclimatized, unselected individuals;*
- *The sustained presence (several minutes) of a heart rate (bpm), above 80% of your maximum heart rate.*
- *Recovery Heart Rate at 1 minute after peak physical effort exceeding 120 bpm*
- *Symptoms of severe and sudden fatigue, nausea, vertigo or dizziness.*



Note: Labour disagrees with the some of the ACGIH definitions and applications.

CROSH Recommendations

- ✓ Real-time monitoring of physiological indicators during high risk jobs or tasks should become standard practice.
- ✓ High heat jobs should incorporate after shift, heat-strain screening with mandatory self-monitoring during shift.
- ✓ Heat strain treatment and action plans should become part of regular practice – linked to screening.

Remember Heat Strain has long-term affects, so consideration needs to be given to: the next shift and job tasks.



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