Working in the Cold

Presented by
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Cold stress

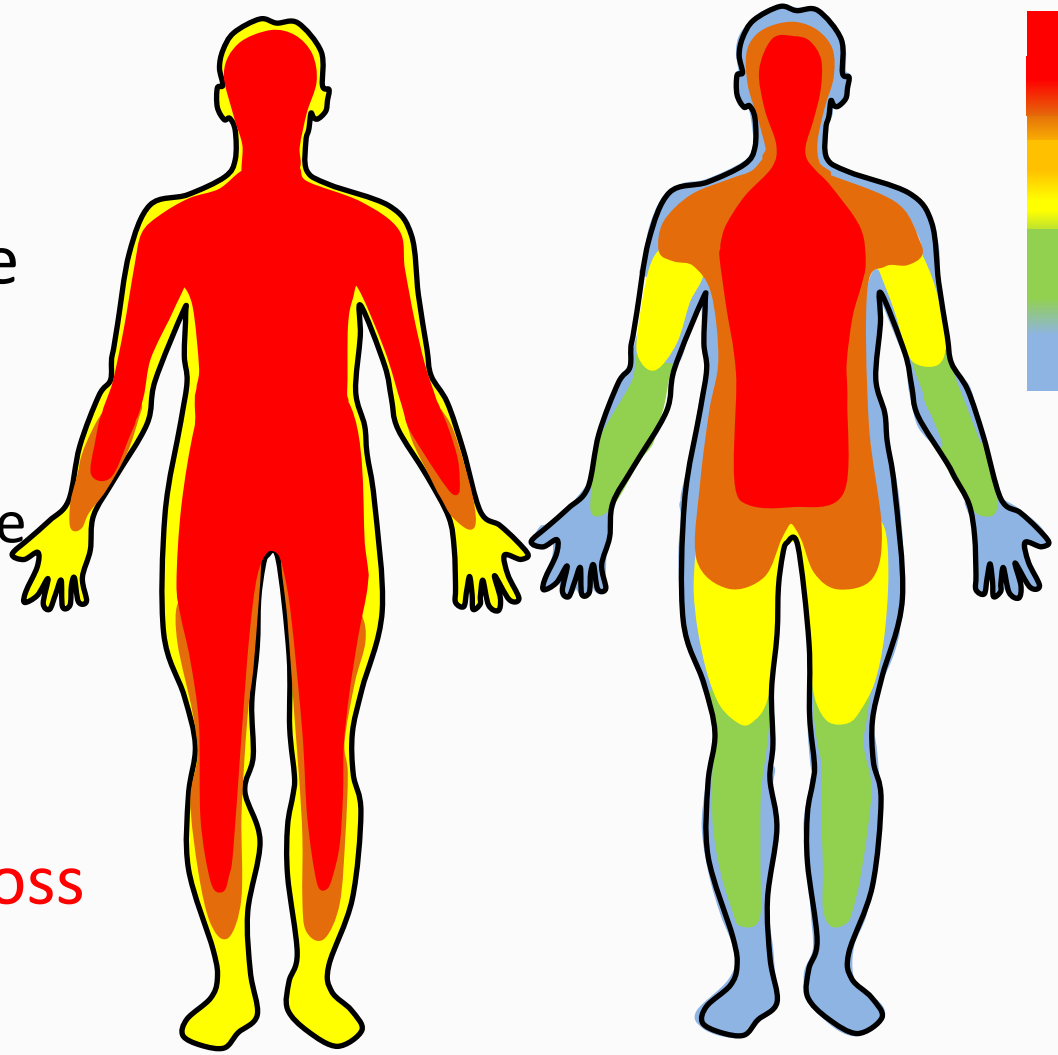
“The principal determinant of cold stress are air temperature and wind speed. Most body heat loss during cold exposure occurs via conductive and convective mechanisms, so when ambient temperature is colder than body temperature, the thermal gradient favors body heat loss, and wind exacerbates heat loss by facilitating convection at the body (Gagge and Gonzalez 1996).”

ACGIH 2019 cold stress documentation

Thermoregulation

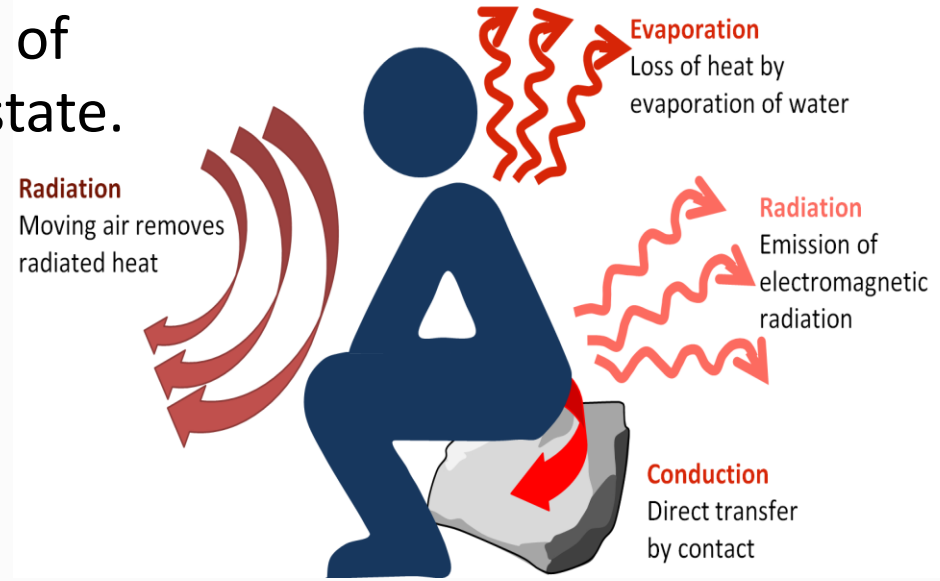
- Thermoregulation is the body's mechanism to balance body's heat exchange with the environment
- Vasoconstriction
  - Arterioles get smaller to reduce blood flow to the peripheries (skin) to keep core warm

Heat gain/generation = Heat loss



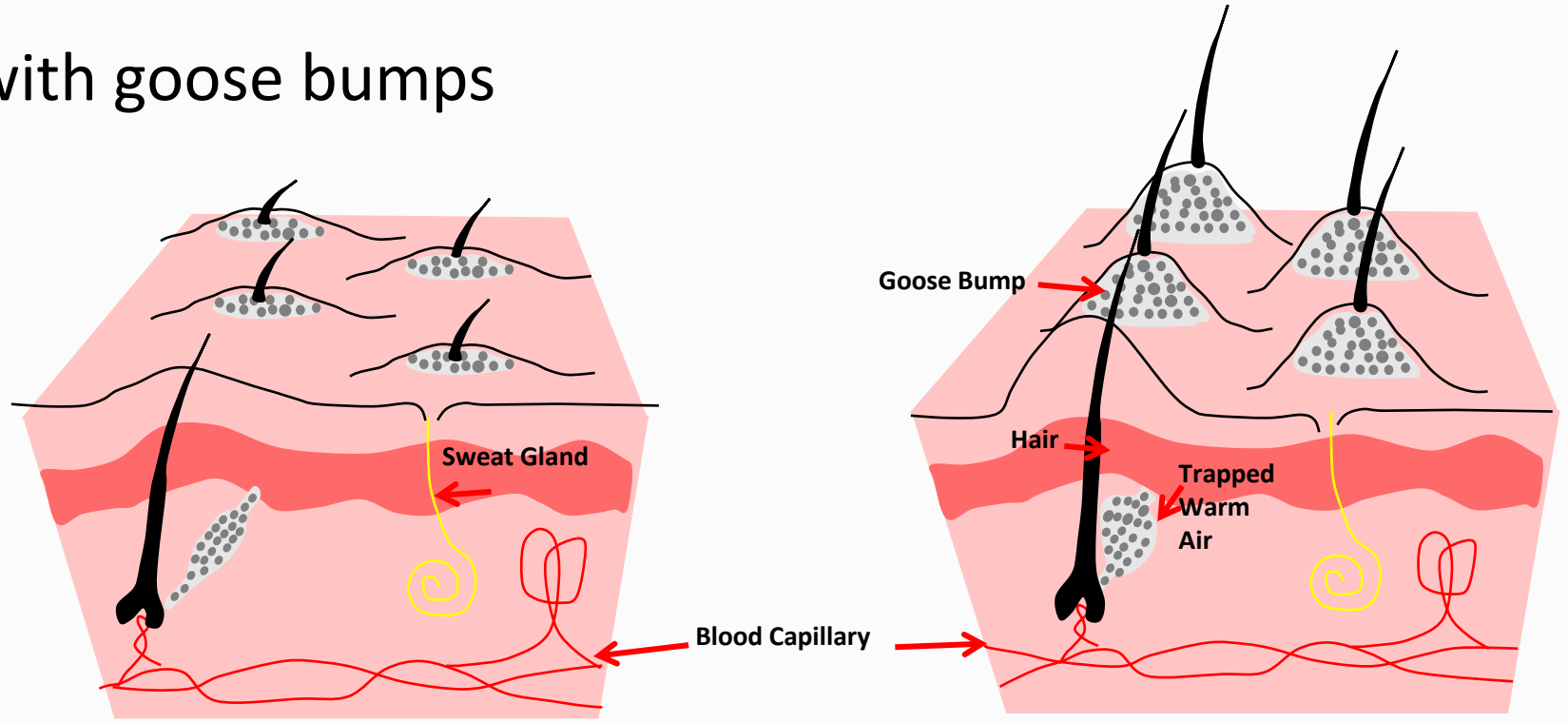
Types of Heat Loss

- *Radiation* – Heat is lost to the environment due to a temperature gradient from an object to the environment.
- *Conduction* – Heat loss through direct contact with a cold object. Heat loss is the greatest when in direct contact with cold water (humans cool 2-10 times faster in cold water).
- *Convection* – Movement of heat from high to low temperature from an object to fluid. In this case fluid can be air and water or internal body fluids.
- *Evaporation* – Loss of heat through the process of changing sweats from liquid state to a gaseous state.

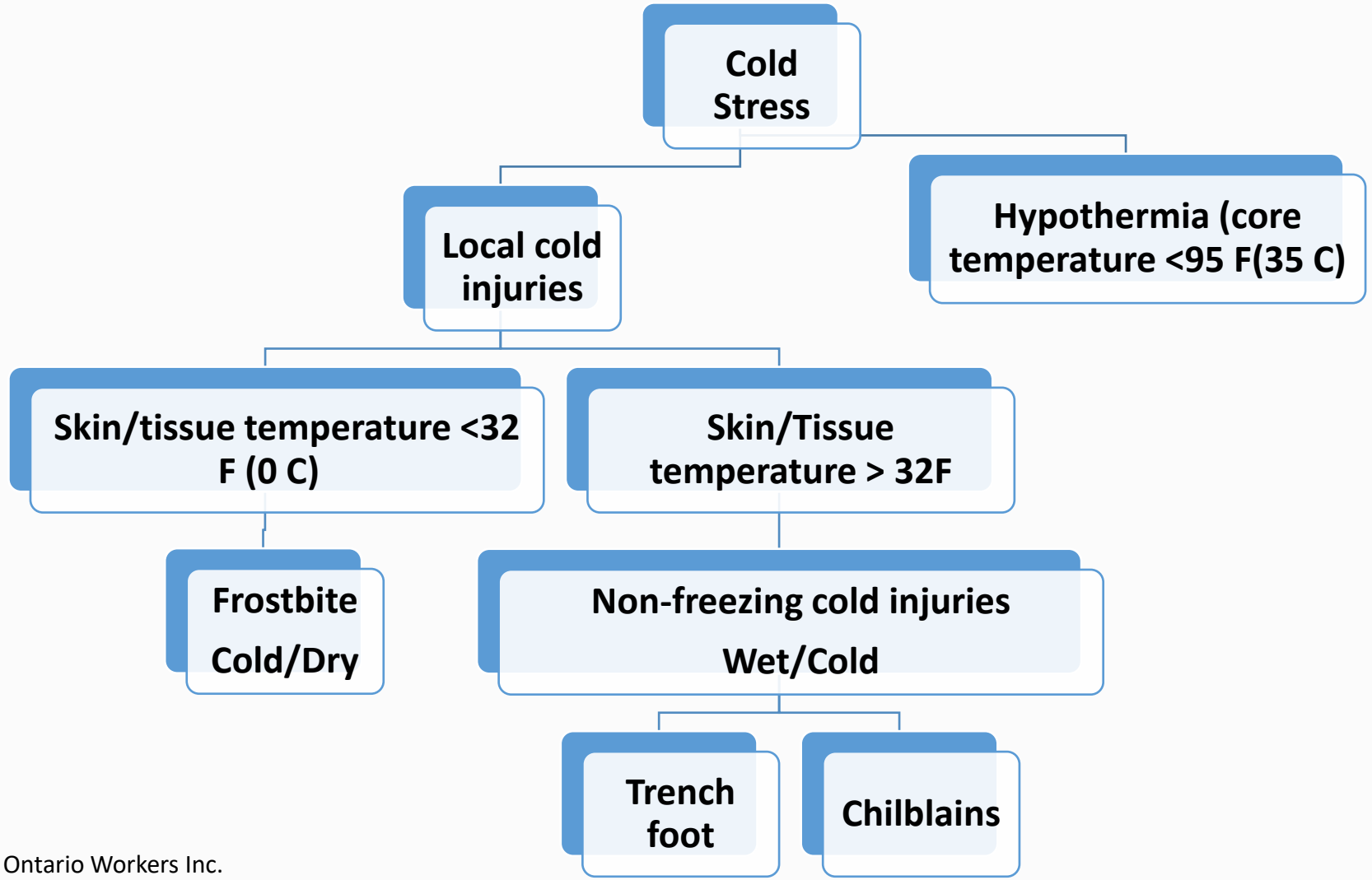


Body's response to the cold

- Peripheral vasoconstriction
- Shivering
- Hair erection with goose bumps



Adverse health effects



Hypothermia

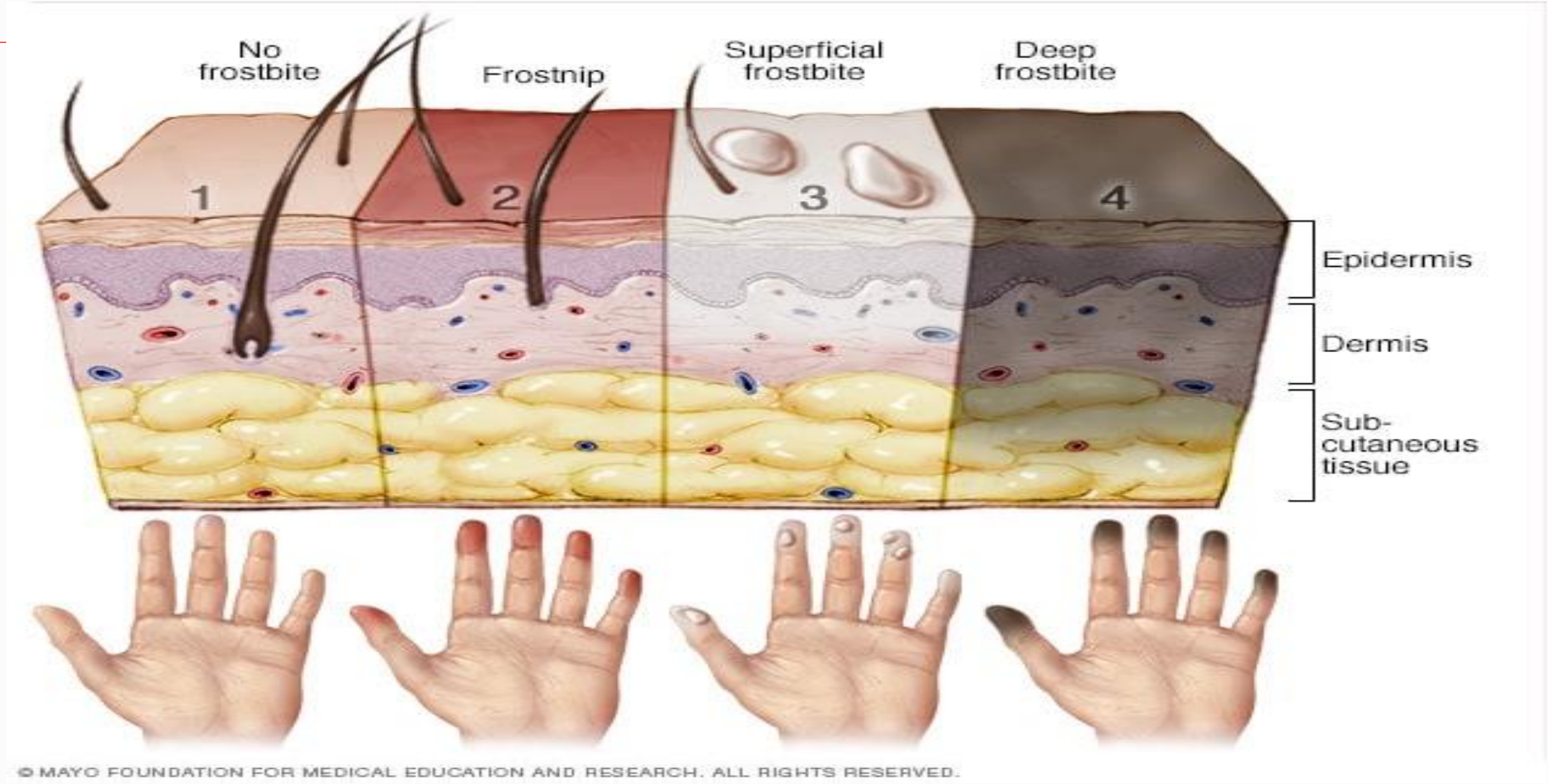
- Clinically, it is defined as body core temperature below 35 °C.
- Hypothermia develops when heat losses exceed heat gain generation which caused core body temperature to drop.
- Early symptoms of hypothermia are feeling cold, shivering, exhibiting signs of lack of interest (apathy), and social withdrawal.
- Pronounced hypothermia includes confusion or sleepiness, slurred speech, and a change in behaviour or appearance.
- Severe hypothermia is associated with cardiac rhythms changes and require immediate treatment to restore body temperature.

Core temperature and physiological responses

Stage	Core Temperature (°C)	Physiological response
Normothermia	37	
Mild Hypothermia	35	Maximal shivering; increased blood pressure
	34	Amnesia; dysarthria; poor judgement; behaviour change
	33	Ataxia; apathy
Moderate Hypothermia	32	Stupor (loss of sense)
	31	Shivering stops; pupil dilate
	30	Cardiac arrythmia and decrease output
	29	Unconsciousness
Severe Hypothermia	28-13.7	Ventricular fibrillation; loss of reflexes; no response to pain etc.

Frostbite

- Frostbite occurs when the tissue temperature falls below 0 °C.
- The skin surface has been reported to be freezing at -3.7 – -4.8 ° C.
- Frostbite is most common in exposed skin such as nose, ear, cheeks, and exposed wrist but it can also be seen in the hands and feet due to peripheral vasoconstriction.
- The first sign of frostbite is numbness which occurs at skin temperature below 10 ° C, however, the cooling sensation starts at 28 ° C.



Frost nip

- It is a reversible ice crystal formation on the skin surface.
- Exposed person is not usually aware that frost nip is occurring because it is usually painless and develops slowly.
- Affects earlobes, fingers, toes, cheeks, and nose.

Non-freezing cold injury (NFCI)

- Chilblains are the painful inflammation of the small skin blood vessels in response to repeated cold exposure (not freezing air) of the skin. It is a superficial skin NFCI which can occur after a few hours of exposure to bare skin.
- Trench foot also known as Immersion foot is caused by cold and wet conditions. It can occur at temperature as high as 15 C in wet conditions from prolonged exposure (estimates vary from >12 hours to 3-4 days). Most common cause of this condition is to wear wet socks and shoes over many days.

Risk factors

- Anthropometric characteristics
- Aging
- Aerobic fitness and training
- Clothing
- Exercise in the cold
- Dehydration
- Cold induced bronchospasm

Cold acclimatization

- Acclimatization can occur upon chronic exposure but the physiological changes are modest.
- It is achieved through habituation, heat acclimatization, and insulative acclimatization.
- Habituation produces less pronounced effects as compare to heat and insulative acclimatization.
- Cold acclimatization is slow to develop and less practical in protecting from cold strain or maintaining normal body temperature.

Wind Chill Temperature (WCT)

Wind chill temperature (WCT)

Air Temperature (°C)

Wind Speed (km/h)	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76
55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

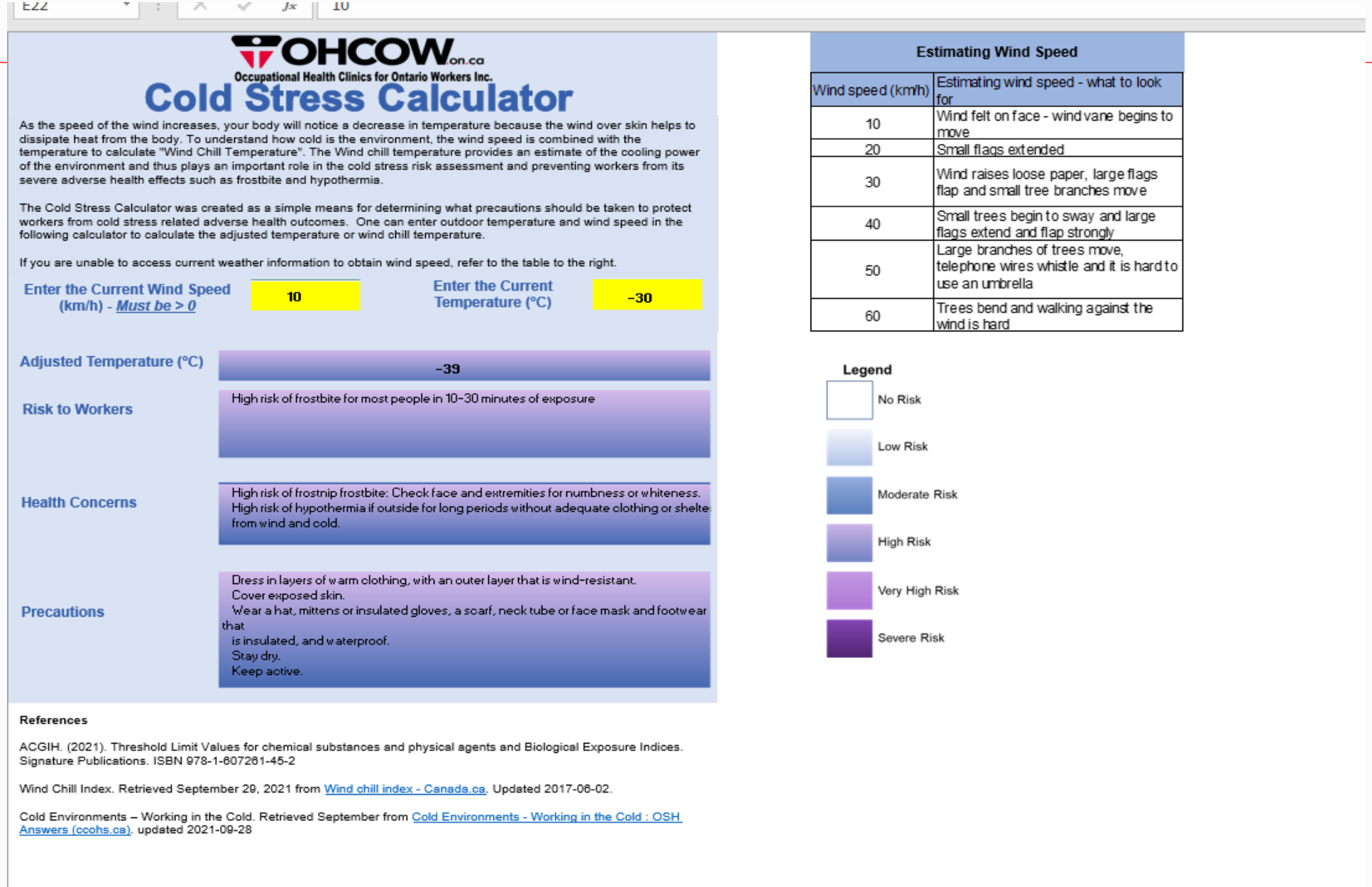
ACGIH TLV book 2021

Frostbite times for exposed facial skin

Wind Chill temperature	Time to frostbite
0 to -27	Low risk for most people
-28 to -39	Increasing risk for most people in 10 to 30 minutes of exposure
-36 to -47	High risk for most people in 5 to 10 minutes of exposure
-44 to -54	High risk for most people in 2 to 5 minutes of exposure
-55 to -81	High risk for most people in 2 minutes of exposure or less

ACGIH TLV book 2021

OHCOW tool



OHCOW.on.ca
Occupational Health Clinics for Ontario Workers Inc.

Cold Stress Calculator

As the speed of the wind increases, your body will notice a decrease in temperature because the wind over skin helps to dissipate heat from the body. To understand how cold is the environment, the wind speed is combined with the temperature to calculate "Wind Chill Temperature". The Wind chill temperature provides an estimate of the cooling power of the environment and thus plays an important role in the cold stress risk assessment and preventing workers from its severe adverse health effects such as frostbite and hypothermia.

The Cold Stress Calculator was created as a simple means for determining what precautions should be taken to protect workers from cold stress related adverse health outcomes. One can enter outdoor temperature and wind speed in the following calculator to calculate the adjusted temperature or wind chill temperature.

If you are unable to access current weather information to obtain wind speed, refer to the table to the right.

Enter the Current Wind Speed (km/h) - *Must be > 0*	10	Enter the Current Temperature (°C)	-30

Adjusted Temperature (°C)	-39
Risk to Workers	High risk of frostbite for most people in 10-30 minutes of exposure
Health Concerns	High risk of frostnip frostbite: Check face and extremities for numbness or whiteness. High risk of hypothermia if outside for long periods without adequate clothing or shelte from wind and cold.
Precautions	Dress in layers of warm clothing, with an outer layer that is wind-resistant. Cover exposed skin. Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and footwear that is insulated, and waterproof. Stay dry. Keep active.

Estimating Wind Speed

Wind speed (km/h)	Estimating wind speed - what to look for
10	Wind felt on face - wind vane begins to move
20	Small flags extended
30	Wind raises loose paper, large flags flap and small tree branches move
40	Small trees begin to sway and large flags extend and flap strongly
50	Large branches of trees move, telephone wires whistle and it is hard to use an umbrella
60	Trees bend and walking against the wind is hard

Legend

- No Risk
- Low Risk
- Moderate Risk
- High Risk
- Very High Risk
- Severe Risk

References

ACGIH. (2021). Threshold Limit Values for chemical substances and physical agents and Biological Exposure Indices. Signature Publications. ISBN 978-1-607261-45-2

Wind Chill Index. Retrieved September 29, 2021 from Wind chill index - Canada.ca. Updated 2017-06-02.

Cold Environments – Working in the Cold. Retrieved September from Cold Environments - Working in the Cold : OSH Answers (ccohs.ca). updated 2021-09-28

Work-warm regimen- Withdrawn by ACGIH

Sunny sky air temperature		No noticeable wind		Wind 8 km/h (5 mph)		Wind 16 km/h (10 mph)		Wind 24 km/h (15 mph)		Wind 32 km/h (20 mph)	
°C below zero*	°F below zero*	Max. work period	Number of breaks**	Max. work period	Number of breaks**	Max. work period	Number of breaks**	Max. work period	Number of breaks**	Max. work period	Number of breaks**
26 to 28	15 to 19	120 minutes	1	120 minutes	1	75 minutes	2	55 minutes	3	40 minutes	4
29 to 31	20 to 24	120 minutes	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
32 to 34	25 to 29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Non-emergency work should stop	
35 to 37	30 to 34	55 minutes	3	40 minutes	4	30 minutes	5	Non-emergency work should stop			
38 to 39	35 to 39	40 minutes	4	30 minutes	5	Non-emergency work should stop					
40 to 42	40 to 44	30 minutes	5	Non-emergency work should stop							
43 and below	45 and below	Non-emergency work should stop									

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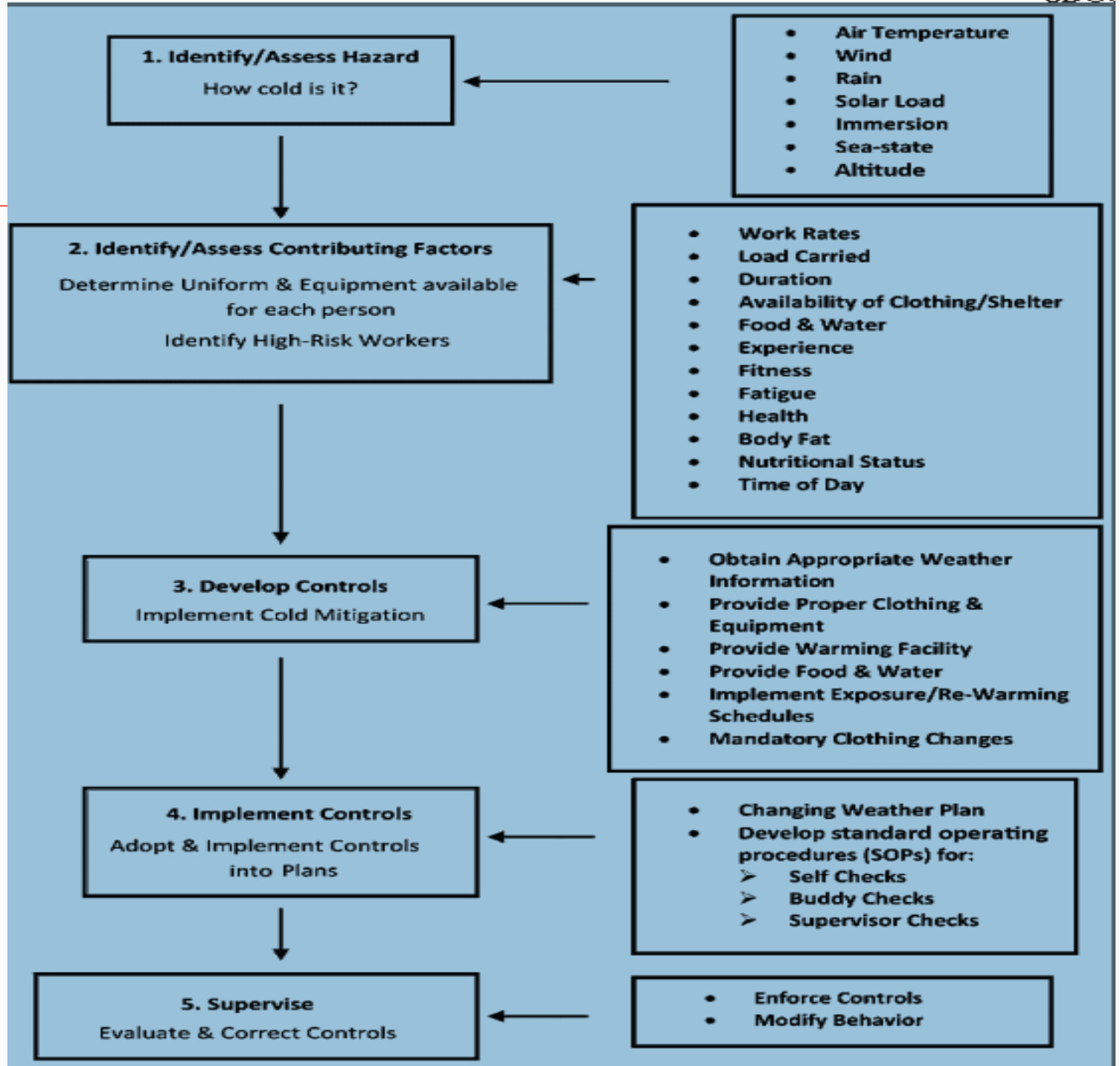
Risk assessment



Risk mitigation

- MLTSD requires employers to develop a cold stress prevention program which addresses worker training, monitoring method, monitoring/sample plan, preventive measures such as proper PPE and warm-up schedule, provide warm shelters and warm liquids, first aid and emergency response plan.
- The training should include recognition of hazards, health effects, prevention of cold related illness, use of proper PPE, and safe work practices.
- Thermometer should be available to measure temperature when it is <16 C and it should be recorded every 4 hours when <-1 C (the wind should also be recorded at <-1 C)

Risk mitigation

- WCT should be obtained and recorded with other data if the WCT is <-7 C.
- Below -12 C the workers should be under observation (buddy system or supervision) and the work pace should be such that excessive sweating does not occur. If so, breaks in warm shelters and dry clothing should be provided.
  - New employees should not work full time from day one so they can acclimatize to the working environment and the protective clothing.
  - Work should be designed as such that the constant sitting or standing is discouraged.

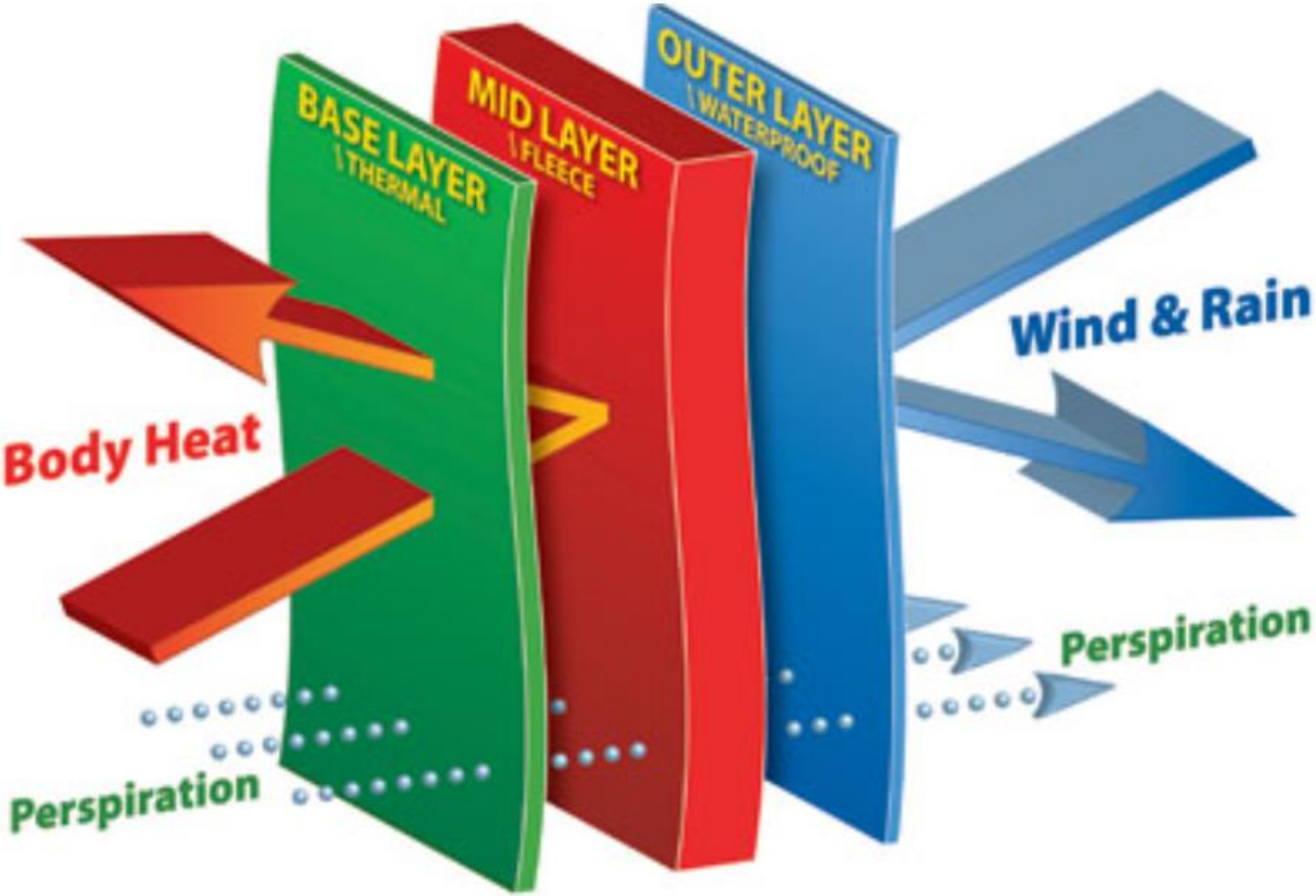
Recommendations for employers

- Schedule maintenance or repair jobs in warmer months if possible
- Schedule cold jobs for the warmer part of the day
- Reduce physical demand of workers
- Use relief workers or assign extra workers for long demanding jobs
- Provide warm liquids to workers
- Provide warm shelters (COVID-19 spread ???)
- Provide worker training to prevent cold stress

NIOSH: Cold Stress Recommendations | NIOSH | CDC

Recommendations for employees

- Wear appropriate clothing in layers of loose clothing. Tight clothing reduces blood circulation to the extremities.
- Protect ears, face, hands, and feet in extremely cold weather
  - Boots should be waterproof and insulated
  - Wear a hat (hats reduces the amount of heat lost by the body)
- Take breaks in the warm shelters or locations and keep hydrated with warm liquids
- Carry extra cold weather gears such as socks, gloves, hat, jacket, a change of clothes
- Avoid touching metal surfaces with bare skin
- Monitor your physical condition and that of your co-workers
- Workers with predisposing health conditions or using certain medications should be extra cautious



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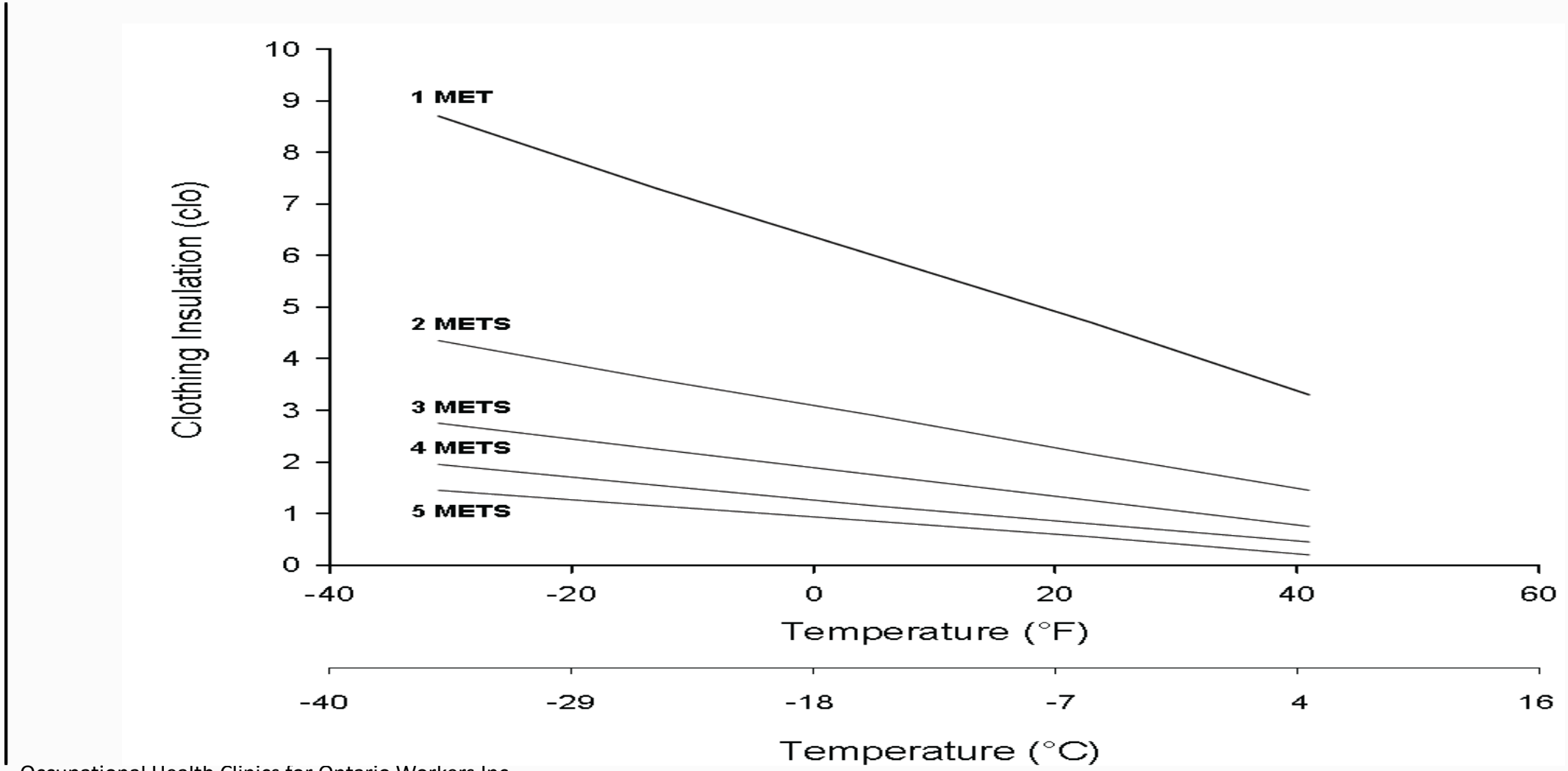
Clothing insulation and METS/Temp



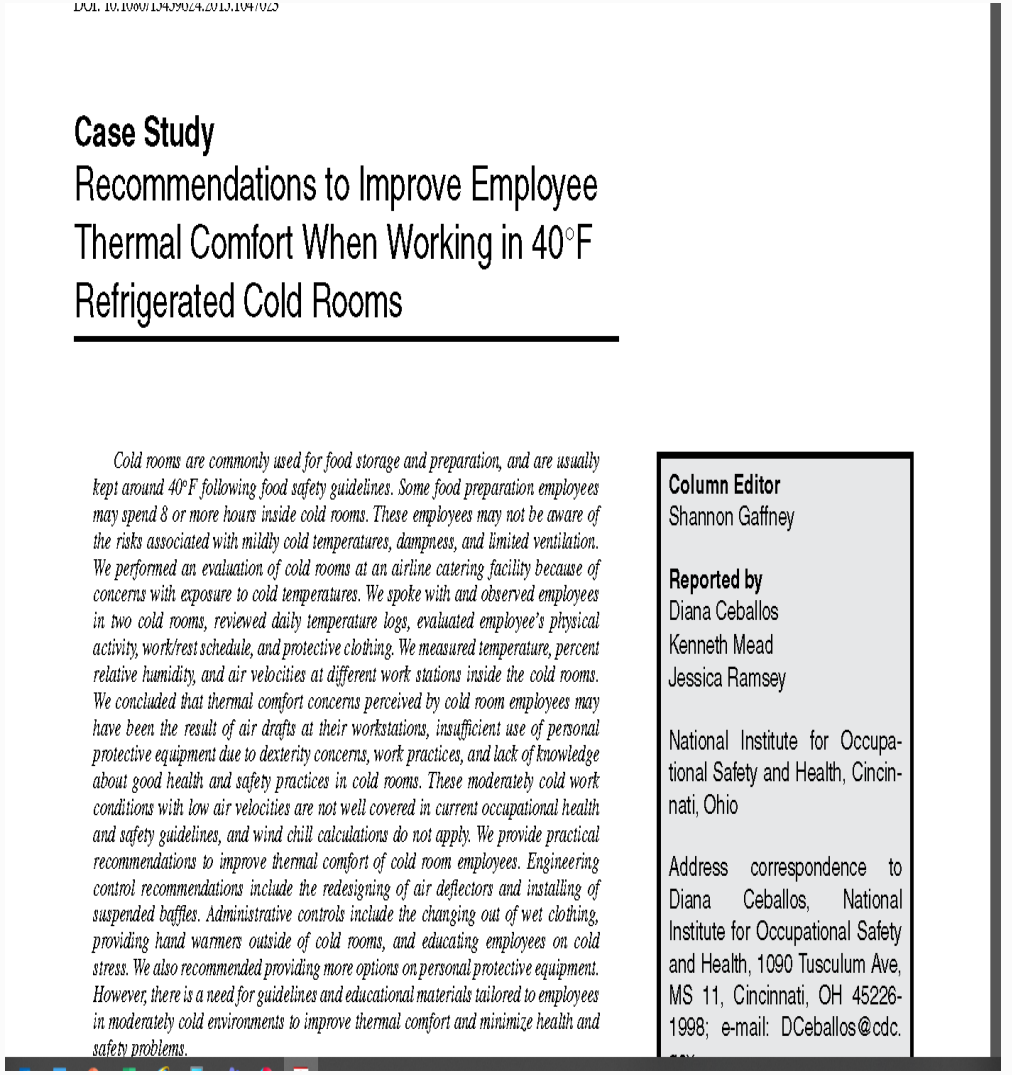
Refrigerated cold rooms

- Most of the literature is about severe cold conditions
- Work-warm regimen does not apply
- Wind chill chart is not applicable
- Thermal discomfort, health and safety and productivity.
- COVID-19 ????

Calculation of storage capacity of cold room - Knowledge - Dongguan COLDMAX Ltd.

NIOSH HHE

- HHE was performed for an airline catering employees who complained about thermal discomfort and cold fingers.
- The temperature was maintained at 40 F (4.4 C) by recirculating the air by air-conditioning units on the roof.



DOI: 10.1080/15459624.2013.764025

Case Study

Recommendations to Improve Employee Thermal Comfort When Working in 40°F Refrigerated Cold Rooms

Cold rooms are commonly used for food storage and preparation, and are usually kept around 40°F following food safety guidelines. Some food preparation employees may spend 8 or more hours inside cold rooms. These employees may not be aware of the risks associated with mildly cold temperatures, dampness, and limited ventilation. We performed an evaluation of cold rooms at an airline catering facility because of concerns with exposure to cold temperatures. We spoke with and observed employees in two cold rooms, reviewed daily temperature logs, evaluated employee's physical activity, work/rest schedule, and protective clothing. We measured temperature, percent relative humidity, and air velocities at different work stations inside the cold rooms. We concluded that thermal comfort concerns perceived by cold room employees may have been the result of air drafts at their workstations, insufficient use of personal protective equipment due to dexterity concerns, work practices, and lack of knowledge about good health and safety practices in cold rooms. These moderately cold work conditions with low air velocities are not well covered in current occupational health and safety guidelines, and wind chill calculations do not apply. We provide practical recommendations to improve thermal comfort of cold room employees. Engineering control recommendations include the redesigning of air deflectors and installing of suspended baffles. Administrative controls include the changing out of wet clothing, providing hand warmers outside of cold rooms, and educating employees on cold stress. We also recommended providing more options on personal protective equipment. However, there is a need for guidelines and educational materials tailored to employees in moderately cold environments to improve thermal comfort and minimize health and safety problems.

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NIOSH recommendations

- Increase the level of activity of the workers by redesigning the work.
- Wear finger less gloves to improve dexterity.
- Redesign deflectors on the fans to redirect air from the employees.
- Hang baffles for the ceiling
- Provide hand warmers
- Allow changing wet clothes and enough time to dry sweats in a warm area.

Relevance to COVID-19 spread

TABLE II. Temperatures and Relative Humidity Measured Inside Cold Rooms

Workstation	Sampling time	% RH[A]		Temperature, °F: Work station 1	Work station 2	Work station 3	Average
Cold room 1	9:06 a.m.–5:04 p.m.	67–95	Average	42	44	44	43
			Minimum	40	43	43	
			Maximum	44	45	47	
Cold room 2	9:06 a.m.–4:45 p.m.	59–89	Average	40	39	NS[B]	41
			Minimum	38	37	NS	
			Maximum	45	41	NS	

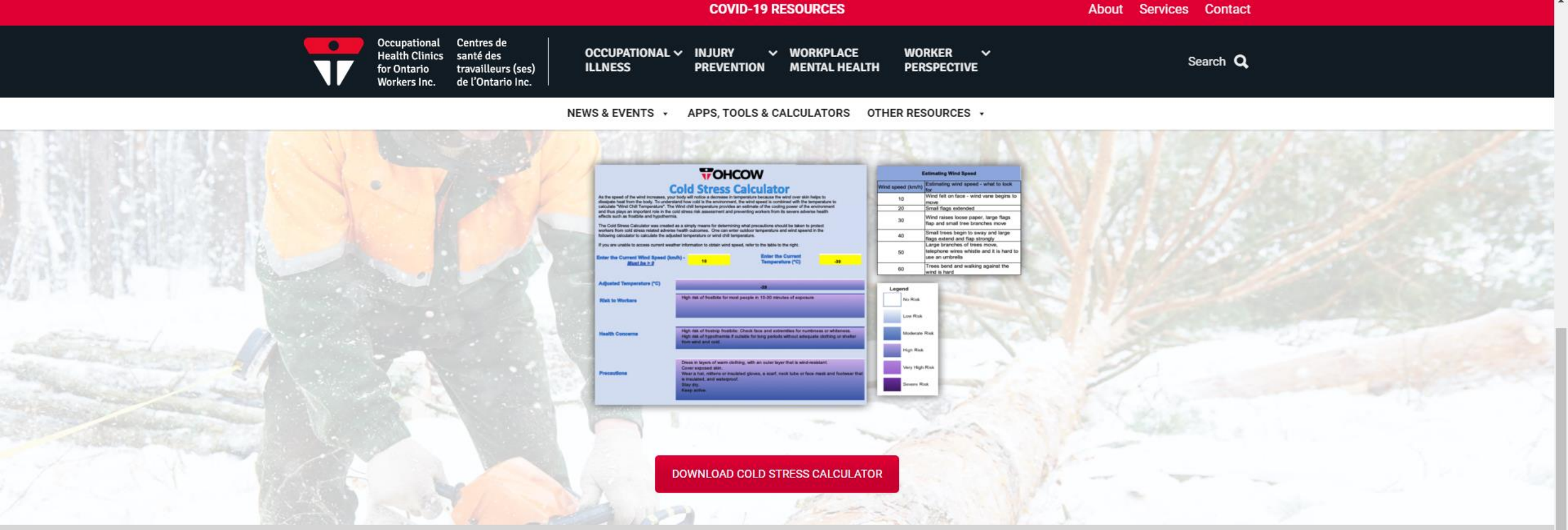
<6 ACH presents high risk for COVID-19 air transmission
SARS-COV2 survives in the air longer if the RH is <30% or >60%

TABLE III. Air Velocities Inside Cold Rooms on September 21, 2011

Work area	Shift	Number of samples	Air velocity[A] (feet per minute average and range)
Cold room 1	Day	7	59.3(14–116)
	Night	7	53.3(24–105)
Cold room 2	Day	6	146.3(30–240)
	Night	6	103.4(25–259)

Notes: [A]A range of air velocities was noted instead of a single value when the

ACGIH 2021 recommends <200 fpm



Resources

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Cold Stress Calculator - OHCOCold Stress Calculator - OHCOWhttps://www.ohcow.on.ca/resources/apps-tools-calculators/cold-stress-calculator/W

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Appendix C: Adverse Weather Conditions | Safety Guidelines for the Film and Television Industry in Ontario

ISBN: 978-1-4249-9952-1
Issued: January 1997
Revised: June 2009
Content last reviewed: August 2010

Adverse Weather Conditions

This information applies to any four-hour period.
Warm-up breaks are assumed to provide 10 minutes in a warm environment.
These guidelines apply to workers wearing dry clothing.

Sunny sky Air Temperature		No noticeable wind		Wind 8 km / h (10 mph)		Wind 16 km / h (10 mph)		Wind 24 km / h (15 mph)		Wind 32 km / h (20 mph)	
°C below zero	°F below zero	Max. work period	Number of work breaks	Max. work period	Number of work breaks	Max. work period	Number of work breaks	Max. work period	Number of work breaks	Max. work period	Number of work breaks
26 to 28	15 to 19	normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	40 minutes	4
29 to 31	20 to 24	normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
32 to 34	25 to 29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Non-emergency work should stop	
35 to 37	30 to 34	55 minutes	3	40 minutes	4	30 minutes	5	Non-emergency work should stop			
38 to	35 to	40	4	30	5	Non-emergency					

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HELP

Cold Environments - Working in the Cold

CLOSE ALL

What factors modify our response to cold?

A cold environment challenges the worker in three ways: by air temperature, air movement (wind speed), and humidity (wetness). In order to work safely, these challenges have to be counterbalanced by proper insulation (layered protective clothing), by physical activity and by controlled exposure to cold (work/rest schedule).

Air Temperature: Air temperature is measured by an ordinary thermometer in degrees Celsius (°C) or degrees Fahrenheit (°F).

Workplace Injury Prevention

Working in Cold Conditions

The Occupational Health and Safety Regulations, 1996 require employers and contractors to take measures to protect the health and safety of the employees who must work outdoors in the cold weather.

Experienced workers usually know the best clothing to wear for their jobs. However, when workers are unexpectedly assigned to outdoor jobs in extremely cold weather, the employer or contractor is expected to:

- Provide appropriate clothing; or
- Allow the workers to obtain suitable clothing before starting the task.

Special attention should be given to good hand and footwear, as well as face and head protection.

How fast a person's body cools in cold weather depends on:

- Air temperature,
- Wind speed,
- Heat of the sun, and
- Work being done.

The fingers and toes usually feel cold first. Shivering then sets in. Shivering is the body's way of warning that it needs to be warmed up. If not warmed, a person may become distracted by the discomfort, and become more likely to have an incident. The risk of frostbite also increases. Employers and contractors should provide a heated warm-up shelter(s) at the workplace where workers can get indoors and out of the cold weather.

The Work The Work Warm-Up Schedule shows the warm-up breaks required for working in cold

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Prevention Through Intervention

https://www.worksafesask.ca/wp-content/uploads/2019/03/Working-in-Cold-Conditions-Fact-Sheet_v4.pdf

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Winter is coming: What to wear for outdoor work

Friday, November 05, 2021

Avoid cotton and goose down to help prevent hypothermia

In Ontario, working outside during the Canadian winter can leave workers susceptible to illnesses like hypothermia or injuries from frostbite. Hypothermia happens when the body's core temperature drops below what is required for normal metabolism and body functions.

"Due to the long-term effects and potential fatalities of cold injury, a few ounces of prevention are worth a pound of cure," says Mike Lemay, Health and Safety Specialist at Workplace Safety

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https://www.cdc.gov/niosh/topics/coldstress/default.html

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Workplace Safety and Health Topics

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Promoting productive workplaces through safety and health research NIOSH

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  - Cold Water Immersion
  - Recommendations
  - Resources

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COLD STRESS

Workers who are exposed to extreme cold or work in cold environments may be at risk of cold stress. Extreme cold weather is a dangerous situation that can bring on health emergencies in susceptible people, such as those without shelter, outdoor workers, and those who work in an area that is poorly insulated or without heat. What constitutes cold stress and its effects can vary across different areas of the country. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered factors for cold stress. Whenever temperatures drop decidedly below normal and as wind speed increases, heat can more rapidly leave your body. These weather-related conditions may lead to serious health problems.

Cold Stress and PPE

Working in Cold Environments and How Your PPE Can Help

Cold-Related Illnesses

Recommendations

Cold Water Immersion

Resources

Features

Preventing Cold-related Illness, Injury, and Death among Workers
Workers, both indoors and outdoors, in services, transportation, agriculture, construction, and other industries may be exposed to environmental cold stress that can lead to thermal discomfort and in some cases even severe injuries, illnesses, or death.

UNITED STATES DEPARTMENT OF LABOR

Occupational Safety and Health Administration

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Safety and Health Topics / Winter Weather

Winter Weather

- Introduction
- Cold Stress
- Preparedness
- Hazards/Precautions
- OSHA Resources
- Additional Resources
- Emergency Preparedness and Response
- **Workers' Rights**

Cold Stress

Cold Stress Can be Prevented

It is important for employers to know the wind chill temperature so that they can gauge workers' exposure risk better and plan how to safely do the work. It is also important to monitor workers' physical condition during tasks, especially new workers who may not be used to working in the cold, or workers returning after spending some time away from work.

The National Oceanic and Atmospheric Administration (NOAA) Weather Radio is a nationwide network of radio stations broadcasting continuous weather information from the nearest NWS office. It will give information when wind chill conditions reach critical thresholds. A Wind Chill Warning is issued when wind chill temperatures are life threatening. A Wind Chill Advisory is issued when wind chill temperatures are potentially hazardous.

- Who is affected by environmental cold?
- What is cold stress?
- How can cold stress be prevented?

Know Your Winter Weather Terms

Blizzard Warning: Issued for sustained or gusty winds of 35 mph or more, and falling or blowing snow creating visibilities at or below 1/4 mile; these conditions should persist for at least 3 hours.

Wind Chill Advisory: Issued when wind chill temperatures are expected to be a significant inconvenience to life with prolonged exposure, and, if caution is not exercised, could lead to hazardous exposure.

Wind Chill Warning: Issued when wind chill temperatures are expected to be hazardous to life within several minutes of exposure.

Winter Storm Warning: Issued

https://www.osha.gov/winter-weather/cold-stress)

-wind-chill-chart

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME | FORECAST | PAST WEATHER | SAFETY | INFORMATION | EDUCATION | NEWS | SEARCH | ABOUT

Wind Chill Chart

Weather.gov > Safety > Wind Chill Chart

Safety
National Program

Extreme Cold Safety | Wind Chill Warning vs Watch | Prepare for Extreme Cold | During Extreme Cold | After Extreme Cold

Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

Cold Resources

- Wind Chill
- Current Watches, Warning and Advisories
- Polar Vortex
- Cold Water Safety
- Forecasts and Observations
- Winter Weather Safety
- Education, Outreach, FAQs
- Links and Partners

The NWS Wind Chill Temperature (WCT) index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. The index does the following:

- Calculates wind speed at an average height of 5 feet, the typical height of an adult human face, based on readings from the national standard height of 33 feet, which is the typical height of an anemometer
- Is based on a human face model
- Incorporates heat transfer theory based on heat loss from the body to its surroundings, during cold and breezy/windy days
- Lowers the calm wind threshold to 3 mph
- Uses a consistent standard for skin tissue resistance
- Assumes no impact from the sun, i.e., clear night sky.

Wind Chill Chart: Color Chart in PDF, Black and White

Wind Chill converted to Knots.

Have more questions? Check our Frequently Asked Wind Chill Questions, Terms and Definitions page and download our free wind chill brochure.

Wind Chill Calculator:

Air Temperature | Celsius | 10

https://www.weather.gov/safety/cold-wind-chill-chart

Thank You!