COVID-19 Applying the Hierarchy of Control to a Point of Care Risk Assessment for the protection of Health Care Workers

Hierarchy of prevention (control banding) for COVID19

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Prevention Through Intervention
Deaths: 480,591

Visualizing the History of Pandemics (Visual Capitalist March 14, 2020)

World Deaths: 480,591 (as of 24 June 2020)
Coronavirus exposure

Airborne vs droplet
Confused

Fact: COVID-19 is NOT airborne. The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or speaks. To protect yourself, keep 1m distance from others, disinfect surfaces frequently, wash your hands, avoid touching your eyes, mouth, and nose.

Precautionary principle approach

“Collectively, these preliminary data suggest that SARS-CoV-2 is resilient in aerosol form.”

Important for interventions

“SARS-CoV-2–infected persons may produce viral bioaerosols that remain infectious for long periods after production through human shedding and airborne transport.”

Evans, 2020
Pre-print June, 4 2020.

Fears et al, 2020
Now Published (June 22, 2020) in Emerging Infectious Diseases.

Important paper

Further studies are needed WHO, March, 29 2020.”

Highlights

- APRNs are on the front line of treatment of COVID-19
- APRNs can help with physical and psychological issues caused by COVID-19
- APRNs must regularly review updates on COVID-19 due to rapidly changing guidelines
- Vulnerable populations will face unique challenges from the pandemic
- COVID-19 affects the mental health of the general population and providers

Abstract

COVID-19 emerged in 2019 and rapidly became a global pandemic infecting millions, killing hundreds of thousands. The disease altered the practices of hospitals, clinics, and patients. These changes have implications for Advanced Practice Registered Nurses (APRNs). APRNs must remain current on best practices for treatment and diagnosis of COVID-19 while being cognizant of changes to their scope of practice. As the pandemic continues, APRNs will remain on the front lines treating COVID-19 patients while also caring for vulnerable populations within the community. To provide high-quality care, APRNs must utilize a multi-faceted approach that heeds ongoing updates to evidence-based practice.
Risk to Canadians

COVID-19 is a serious health threat, and the situation is evolving daily. The risk will vary between and within communities, but given the increasing number of cases in Canada, the risk to Canadians is considered high. This does not mean that all Canadians will get the disease. It means that there is already a significant impact on our health care system. If we do not flatten the epidemic curve now, the increase of COVID-19 cases could impact health care resources available to Canadians.

We continue to reassess the public health risk based on the best available evidence as the situation evolves.

Who is most at risk

While COVID-19 can make anyone sick, some Canadians with specific health circumstances are at an increased risk of more severe outcomes, including individuals:

- aged 65 and over
- with compromised immune systems
- with underlying medical conditions

In addition, social and economic circumstances may also be a factor in identifying someone who is vulnerable to COVID-19. This includes anyone who has:

- economic barriers
- difficulty accessing transportation
- difficulty accessing medical care or health advice
- unstable employment or inflexible working conditions
- insecure, inadequate, or nonexistent housing conditions
- ongoing specialized medical care or needs specific medical supplies
- social or geographic isolation, like in remote and isolated communities
- difficulty reading, speaking, understanding or communicating
- ongoing supervision needs or support for maintaining independence
- difficulty doing preventive activities, like frequent hand washing and covering coughs and sneezes

Think you might have COVID-19?

[Take a self-assessment]
• There’s growing consensus as the literature emerges about how people can become infected. Fleeting encounters with people outdoors are unlikely to spread the coronavirus. **It seems now that the major culprit is close-up, person-to-person interactions for extended periods.** Crowded events, poorly ventilated areas and places where people are talking loudly—or singing in a group indoors has a much higher risk. There is also a concern about asymptomatic and pre-symptomatic individuals being contagious.

• Health agencies have so far identified respiratory-droplet contact as the major mode of Covid-19 transmission. These large fluid droplets can transfer virus from one person to another if they land on the eyes, nose or mouth. But they tend to fall to the ground or on other surfaces pretty quickly.

• Since the outset (or even prior) to the pandemic, **evidence that the coronavirus can also be transmitted through aerosols, or minuscule droplets that float in the air longer than large droplets, has gotten much stronger.** These aerosols can be directly inhaled. It is assumed by Evans et al. 2020, p.1, (pre-print)- where hand hygiene protocols are in place and face coverings are worn to catch large droplets, aerosols are the dominant transmission mechanism. **The mounting evidence for this mode of transmission reinforces the precautionary principle approach for all workers and their families.**
Coronavirus – transmission (how can it spread)?

Three routes of exposure: Aerosol, droplet and fomite (hand to mouth)
There is emerging evidence that coronavirus can be airborne – see
“Is COVID-19 airborne?”, Drs. Chad Roy & Ed Zuroweste (Migrant Clinicians Network)

Dr. Brosseau is a national expert on respiratory protection and infectious diseases professor (retired), University of Illinois at Chicago
Aerosol transmission and respiratory protection . University of Minnesota, Center for Infectious Disease Research and Policy (CIDRAP).

“Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures” (ASHRAE, 2020).

“Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. transmission of the virus” (ASHRAE, 2020).

Why air conditioning / ventilation is so important

Therefore should follow precautionary approach

See ASHRAE COVID-19 (Coronavirus) Preparedness Resources
Aerosols can be generated by natural processes:
• Vomit
• Hemorrhage
• Diarrhea (toilet flushing)
• Coughing
• Sneezing
• Talking

Aerosols can be generated by medical procedures:
• Intubation
• Bronchoscopy
• Drug delivery
• Respiratory support

AEROSOL GENERATION

Inhalation can occur at the time and near the point of generation

At time = 0, an aerosol is generated by person A. Person B receives droplet spray and inhales particles. Person C has no exposure.

Courtesy of, and thank you, to Dr. Lisa Brosseau & Dr. Rachael Jones
University of Minnesota Center for Infectious Disease Research and Policy (CIDRAP) and Absolute Science Illustration
AEROSOL SETTLING AND DIFFUSION

Inhalation is possible near and further from the point of generation. Inhalation continues to be possible near the source as settling and diffusion take place.

Aerosol transmission (inhalation) is possible further from the source over time.

Infection depends on organism viability and dose (concentration of organisms in aerosol).

At time = 1, the aerosol is dispersing, and many larger particles are settling. Person B inhales particles. Person C has no exposure.

Courtesy of, and thank you, to Dr. Lisa Brosseau & Dr. Rachael Jones University of Minnesota Center for Infectious Disease Research and Policy (CIDRAP) and Absolute Science Illustration
Aerosol transmission (inhalation) is possible throughout the space.

Infection depends on organism viability and dose (concentration of organisms in aerosol).

At time = 2, the aerosol is dispersed, and many larger particles have deposited on the floor. Persons B and C inhale particles.

Courtesy of, and thank you, to Dr. Lisa Brosseau & Dr. Rachael Jones
University of Minnesota Center for Infectious Disease Research and Policy (CIDRAP) and Absolute Science Illustration

How can airborne transmission of COVID-19 indoors be minimised?

Morawska et al. 2020, https://scholar.colorado.edu/downloads/4m90dw55b
Can control banding help us to more clearly communicate the risk and therefore apply protective measures where they are more badly needed?

“Control banding may be used to assign job tasks into risk categories and prioritize the application of controls” (Sietsema et al. 2020, p.124).

Control banding models, first developed for pharmaceutical and chemical hazards, use toxicity and exposure information to qualitatively categorize risk into several levels or “bands,” which are then used to guide the selection of appropriate “controls,” or methods for eliminating or minimizing risk (Sietsema et al. 2020, p.125).
Risk Communication and Control Banding (CB)

The Stoplight Effect – What do you do at a yellow?

STOP!

- Stop every time?
- Go every time?
- Assess traffic, then decide?
- Speed limit vs. your speed?

... or CHECK FOR POLICE?

GO!
Toxicity and exposure levels are relatively easy to predict or measure for chemical exposures, but ascribing them to biological exposures is more difficult. For biological organisms, several factors contribute to the hazard, including virulence, infectivity, and pathogenicity.

- **Virulence** is a measure of the severity of the consequences of infection;
- **infectivity** is measured by the number of organisms required to induce infection; and
- **pathogenicity** is the ability of an organism to cause disease.

For many human pathogens, we do not fully understand and cannot easily measure the virulence, infectious dose, pathogenicity, and/or route(s) of transmission (Sietsema et al. 2020, p.125). The US Department of Labor, Occupational Safety and Health Administration (OSHA) **has simplified the process** by assigning risk levels to different jobs and assigning controls based on the risk level which is described in more detail in:

Coronavirus – what is the risk of getting COVID-19 (workplace).

Many risk factors to consider including:

- **Proximity** (e.g. Ophthalmologist).
- **Time**.
- **Number of contacts**.
- **Space < 2 metres etc.**

Think of infectious people as point sources (Brosseau, L).

Each situation will require an assessment that should also consider “community transmission”.

For an additional description of the risk levels* and classifying workers at risk refer to: US Occupational Health and Safety Administration (OSHA), COVID-19, Hazard Recognition, Occupational Health Clinics for Ontario Workers Inc. Prevention Through Intervention
Coronavirus – what is the risk of getting COVID 19 (workplace).

<table>
<thead>
<tr>
<th>Medium Risk</th>
<th>High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care workers or hospital ancillary staff.</td>
<td>Areas of healthcare facilities where public or patients present.</td>
<td>Health care workers (HCW) performing aerosol generating procedures; IHW or laboratory workers collecting or handling specimens from known or suspected COVID-19 patients; Mortgage workers performing autopsies*; Dentists and dental technicians.</td>
</tr>
<tr>
<td><strong>See: Point of Care Risk Assessment</strong></td>
<td>If there is treatment required that requires AGPs then the risk becomes very high.</td>
<td>May not be possible. Physical distance not possible as much personal contact occurs with engineering control — general and localised ventilation.</td>
</tr>
</tbody>
</table>

**Elimination/Physical Distancing**
- Support & enable telework and/or curbside service where able.
- Maintain physical distance ~2 metres or more as possible.
- Clear communication of occupancy signage (eg: red/green).
- 6 & manage protocol for points of contact & contamination.
- Minimise use of Telework/sites.
- External test for France.
- Physical barriers and crowd management procedures in place. Physical distance not possible to much change lower order control starting off with engineering control.

**Engineering Controls**
- Ventilation: Minimize air changes, including opening windows & doors as weather feasible. 
- Good practices around ventilation.
- Personal barriers: DIAP. 
- Workplaces reduce to reflect density. 
- Use alone or purifying devices. 
- Reduce furniture, mark floors, organise flow.

**Administrative Controls**
- Hazard awareness training. 
- Work schedule location & flow to minimize congestion. 
- Comprehensive education in wear awareness & understanding. 
- Personal hygiene (frequent hand washing etc)
- Sanitation/Workspaces/Cleaning.
- Safe work practices.
- Facilities & support issued & risk communication training workers.
- Regular & reliable competency based training. 
- Training of correct use of personal protective equipment (PPE) use.
- PPE program including CE & 2014.
- Non-Clinical areas: basic PPE to minimize in and out.
- Break staff pockets over.
- App: execution & communication protocol.
- Frequent, thorough environmental cleaning.
- Personal breaks to reduce fatigue and personal hygiene.

**Personal protective equipment (PPE)**
- Where physical distancing is not possible. Consider face masks for all personnel (face covering) to maximize protection. There may be some situations where minimisation is unachievable, and no personal protection equipment is worn. In these cases, PPE will still be worn where an MSS is required. A risk assessment will inform whether an MSS is required. PPE (CEA Standard Z49.1 & should be followed) as a minimum and personal protective equipment, specific to the local situation, is recommended and used.
- N95 mask (as a minimum), PPE (including gloves, face shield, fluid resistant isolation gowns, high risk isolation gowns).

**Drug & Procedure**
- For an additional description of the risk levels* and classifying workers at risk refer to: US Occupational Health and Safety Administration (OSHA), COVID-19, Hazard Recognition.

OCCUPATIONAL HEALTH CLINICS FOR ONTARIO WORKERS INC.
PREVENTION THROUGH INTERVENTION

- **Medium Risk**
  - High care workers: PPE (including mask, eyewear, gloves, gown, or apron).
  - PPE (including mask, eyewear, gloves, gown, or apron).
- **High Risk**
  - PPE (including mask, eyewear, gloves, gown, or apron).
  - PPE (including mask, eyewear, gloves, gown, or apron).
- **Very High Risk**
  - PPE (including mask, eyewear, gloves, gown, or apron).

- **Most Effective**
  - Increased ventilation is very important.
  - Training in proper use of PPE is very important.
  - Selection of PPE is very important (including fit testing of Respirators).
### Lawrence Livermore National Laboratory (LLNL) Control Banding (CB) for Respirators which includes Health Care Workers (HCW).

Courtesy of Dr. Dave Zalk author of Control Banding “A Simplified, Qualitative Strategy for the Assessment of Occupational Risks and Selection of Solutions”.

Presentation delivered through Workplace Health Without Borders (International) by Dr. Dave Zalk who is also a BoD member with WHWB (International).

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## COVID-19; LLNL CB for Respirators

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<th>Risk Level</th>
<th>Examples</th>
<th>Respirator Controls - Equipment</th>
<th>Respirator Controls - Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Low)</td>
<td>Jobs that do not require contact with known or suspected SARS-CoV-2 infected people nor frequent contact with the general public. Minimal occupational contact with public and other coworkers. Working at home during shelter-in-place or working in the office where social distancing (&gt;6 feet) can be maintained with other co-workers.</td>
<td>None required. Surgical mask or N95 respirator can be worn voluntarily.</td>
<td>Read and understand the NS5 permit that is included with the respirator.</td>
</tr>
<tr>
<td>2 (Medium)</td>
<td>Jobs (including healthcare workers) that include frequent and/or close contact with (within 6 feet) of people who may be infected with SARS-CoV-2 but who are not known or suspected COVID-19 patients. In areas with ongoing community transmission, workers who have contact with the general public (schools, crowded work or retail environments).</td>
<td>Wear N95 filtering facemask respirator when social distancing (&gt;6 feet) is not possible in the work area. Replace respirator when it becomes damaged, soiled, or if breathing becomes difficult.</td>
<td>Read and understand the PPE controls in the work control document. Read and understand the NS5 permit that is included with the respirator. Ensure facial hair is not present between the face and sealing surfaces of the respirator.</td>
</tr>
<tr>
<td>3 (High)</td>
<td>Healthcare delivery and support staff exposed to known or suspected COVID-19 patients, medical transport workers moving known or suspected COVID-19 patients in enclosed vehicles, morgue workers preparing the bodies of deceased COVID-19 patients.</td>
<td>Wear N100 filtering facemask respirator (if successful quantitative fit-test has been documented) or higher-level respirator, such as HF APR, FF APR, or PAPR (if successful fit-test has been documented). Replace respirator when it becomes damaged, soiled, or if breathing becomes difficult.</td>
<td>Respirator Approval Form signed by supervisor and HSD. Annual completion of HS4610-W (web course) and HS4610-P (fit-test/practical training).</td>
</tr>
<tr>
<td>4 (Very High)</td>
<td>Healthcare workers performing aerosol-generating procedures on known or suspected COVID-19 patients or collecting or handling specimens from known or suspected COVID-19 patients, morgue workers performing autopsies on deceased COVID-19 patients.</td>
<td>Wear HF APR, FF APR, or PAPR (if successful fit-test has been documented). Replace HEPA cartridges when breathing becomes difficult.</td>
<td>Respirator Approval Form signed by supervisor and HSD. Annual completion of HS4610-W (web course) and HS4610-P (fit-test/practical training).</td>
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Occupational Health Clinics for Ontario Workers Inc.
Prevention Through Intervention
Workplace Health Without Borders WHWB

Occupational Health Clinics for Ontario Workers Inc.
Prevention Through Intervention

https://www.youtube.com/channel/UCj5PLvW65Lr0feLYGVLBmQ
Dr. Zalk’s presentation is available on YouTube:
https://www.youtube.com/watch?v=hZJ81otqMfg
Each situation will require an assessment that should also consider community transmission.
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Control banding is about risk management!

Cumulative rate of COVID-19 cases per 100,000 population
(Jan 15 - Jun 23, 2020)

Occupational Health Clinics for Ontario Workers Inc.
Prevention Through Intervention

Courtesy of, and thank you to John Oudyk, OHCOW
For a more detailed risk assessment methodology in “non health care settings” Sietsema et al. 2020 has proposed a method based using the National Institutes of Health (NIH) risk groups as a surrogate for toxicity and combining the exposure duration with the exposure likelihood, we can generate the risk of a job task to the worker.

For health care settings in general, healthcare workers are in the highest risk category and are addressed elsewhere and Sietsema et al. 2020 refers to Guidance on Preparing Workplaces for an Influenza Pandemic. 2009.

More recently OSHA Guidance on Control and Prevention (OSHA, 2020):
https://www.osha.gov/SLTC/covid-19/controlprevention.html Under health care the following is provided:
Identify and Isolate Suspected Cases

- In workplaces where exposure to COVID-19 may occur, prompt identification and isolation of potentially infectious individuals is a critical first step in protecting workers, visitors, and others at the work site.
- Wherever feasible, immediately isolate individuals suspected of having COVID-19. For example, move potentially infectious individuals to isolation rooms. On an aircraft, if possible and without compromising aviation safety, move potentially infectious individuals to seats away from passengers and crew. In other work sites, move potentially infectious individuals to a location away from workers, customers, and other visitors and with a closed door, if possible.
- Take steps to limit the spread of the individual’s infectious respiratory secretions, including by providing them a facemask and asking them to wear it, if they can tolerate doing so. Note: A surgical mask on a patient or other sick person should not be confused with PPE for a worker; the surgical mask acts to contain potentially infectious respiratory secretions at the source (i.e., the person’s nose and mouth).
- After isolation, the next steps depend on the type of workplace. For example:
  - In most types of workplaces (i.e., those outside of healthcare):
    - Isolated individuals should leave the work site as soon as possible. Depending on the severity of the isolated individual’s illness, he or she might be able to return home or seek medical care on his or her own, but some individuals may need emergency medical services.
  - In healthcare workplaces:
    - If possible, isolate patients suspected of having COVID-19 separately from those with confirmed cases of the virus to prevent further transmission, including in screening, triage, or healthcare facilities.
    - Restrict the number of personnel entering isolation areas, including the room of a patient with suspected or confirmed COVID-19.
    - Protect workers in close contact* with the sick person by using additional engineering and administrative controls, safe work practices, and PPE.
    - Sick workers should leave the work site as soon as possible. Depending on the severity of the isolated worker’s illness, he or she might be able to return home or seek medical care on his or her own, but some individuals may need emergency medical services.

*CDC defines close contact as being within about 6 feet of an infected person while not wearing recommended PPE. Close contact also includes instances where there is direct contact with infectious secretions while not wearing recommended PPE. Close contact generally does not include brief interactions, such as walking past a person.

https://www.osha.gov/SLTC/covid-19/controlprevention.html
• Three routes of exposure: aerosol, droplet and fomite (hand to mouth) should be considered in the PCRA.

• To help guide the health care worker (HCW) “determine” whether they are “adequately protected” against infection: prior to treating the suspected COVID 19 patient, a point of care risk assessment will inform whether the controls are suitably protective. (This will be discussed further).

• A risk assessment will provide the impetus to ensure that the hierarchy of control approach has been followed (for example, ventilation at ≥12 Air Changes per Hour (ACH) & negative pressure to prevent airborne microorganisms in the room from entering hallways and corridors in a COVID19 isolation ward – refer to CDC Infection Control “Air”) and precautionary principle be applied.

• It is important to engage a “Certified” Occupational / Industrial Hygienist for guidance and support, to help set up programs and verify that the controls are in fact effective.
Dr. Brosseau’s presentation is now available on YouTube (PLEASE SHARE)
https://www.youtube.com/watch?v=dGK2R3O0fWc&feature=youtu.be
• Under the Occupational Health and Safety Act (OHSA), your employer must take every precaution in the circumstances for the protection of a worker. **This includes the whole hierarchy of controls**, but especially at minimum an N95 respirator to a healthcare worker who is working in situations with a significant risk of being exposed to COVID. **This is your legal right.**

• Your right to a higher level of Personal Protective Equipment (PPE) is strongly supported by research that there is airborne transmission of the virus as well as droplet/contact. This is especially significant for workers at close quarters with potentially infectious patients, even when not performing aerosol-generating procedures.

• All healthcare workers should do a point of care risk assessment (PCRA) before heading into hazardous working conditions.

(Alec Farquhar)