Environmentally Responsible PPE

Made in Canada
Canadian-owned
Canadian content

Support in part by:
- Next Generation Manufacturing Canada (NGen)
- Innovation, Science and Economic Development Canada (ISED Canada)

Barry Hunt, President
Paul Sweeney, Vice-President
Martin Petrak, Executive
Anthony Zhao, Executive
Nancy Henry, Executive
Jason Zanatta, Executive
CAPPEM is a not-for-profit organization.

Our member companies develop, manufacture and sell medical masks & respirators.
Canada’s Plan

“Challenge innovative companies to develop research-based solutions, technologies, and products that can address a variety of COVID-19 issues.”

“supporting Canadian manufacturers of personal protective equipment (PPE) to build domestic capacity”
Working Together
CoVID
Reduce Airborne Transmission
39,000,000 Canadians
3,000,000

HCWs
29,000,000 Hospitalizations
250,000

Long-Term Care Residents
1,000,000

Teachers & support staff
7,500,000 Students
Community Cases

Schools ~40%

Healthcare ~25%
Threats

1. CoVID is Not Over
2. Long Covid
3. Next pandemic
4. Lab leaks
5. Bioterrorism
6. Supply chain
   1. China – Taiwan, Russia, trade war
   2. US – Defence Production Act
Time to End Single Use Plastics

- straws
- stir sticks
- checkout bags
- ring carriers
- cutlery
- foodservice ware
Time to End Single Use Plastics

- Medical Masks
- Respirators
Federal Govt

- Innovation support
- Unanimous Consent Motion – Buy Canadian PPE
- PSPC Policy – Buy Canadian PPE
- Environmental Policy – Buy green PPE
Ensuring that the intended outcomes of the procurement are aligned with the departmental mandate and priorities, available funds, and key socio-economic and environmental benefits:

Where appropriate, including environmental considerations when specifying requirements for goods, services and construction and leveraging procurement practices in accordance with the Policy on Green Procurement.
Guidance to Reduce the Environmental Impacts of Waste Throughout the Personal Protective Equipment (PPE) Lifecycle
“9.2.3 Innovation
☐ Take steps centrally to facilitate the systematic consideration of “green criteria” in PPE procurement decisions. For example, including environmental considerations when PPE supply arrangements are being renewed.

☐ Identify opportunities for the federal government to lead by example and highlight emerging technologies related to the manufacture, use and disposal of PPE, with the objective of supporting wider availability of products that aim to reduce the overall environmental impact.”
Canada’s Green PPE Guidance

Several departments, agencies and programs were consulted on specific aspects of the Guidance, including:

- Environment and Climate Change Canada – environmental management and waste;
- Public Services and Procurement Canada – procurement and waste;
- Public Service Occupational Health Program – health and safety requirements; and,
- Treasury Board Secretariat and the Centre for Greening Government – partnership and coordination.

In addition, the Guidance was informed by advice and input from an interdepartmental Working Group with representation from the following departments:

- Correctional Service of Canada
- Department of National Defence
- Environment & Climate Change Canada
- Fisheries and Oceans Canada
- Health Canada
- Transport Canada
- Treasury Board Secretariat
- Public Services and Procurement Canada
Carbon Footprint

<table>
<thead>
<tr>
<th></th>
<th>SUP</th>
<th>CDN Sup</th>
<th>Plant-Based</th>
<th>Reusable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>80</td>
<td>30</td>
<td>5</td>
</tr>
</tbody>
</table>

- CDN Sup: 80
- Plant-Based: 30
- Reusable: 5

CAPPEM Certified
CAPPEM Canadian Content

- 20% in 2021
- 40% in 2022
- 80% in 2023
- 100% in 2024
Made In Canada

Meltblown
- Nanofibre
- Easy breathing
- Plant-based

Spunbond
- Plant-based

SUPs
- Plant-based

Disposable
- Plant-based

Reusable
Made In Canada

2021
- Medical Masks
- Disposable Respirators
- Reusable Respirators
- Polypropylene Meltblown

2022
- Plant-based Plastic
- Plant-based Meltblown
- Plant-based Spunbond
- Nose Wire
- Ear Loops

2023
- Polypropylene Spunbond
- Polypropylene Resin

2024
Made In Canada
Plant-based
Plant-based

Partial Funding

[Logos for NGen and NRC-CNRC Canada]
Reusables

10X more protective

10X more environmentally-friendly

10X lower cost
“Made in Canada reusable respirator. Better protection less waste. Should be standard issue by now...”
Non-Sterile Devices

1. Personal protective device
2. Do not remove in a contaminated environment
3. Do not sterilize or change filters between patients
1. Assign to individual HCW
2. Store in clean location
3. Clean daily with wipes or warm, soapy water
3. Decontaminate as indicated with alcohol wipes, UV, washer-disinfector
<table>
<thead>
<tr>
<th></th>
<th>Disposables (4 / day)</th>
<th>Reusables (Daily)</th>
<th>Reusables (Weekly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes Waste</td>
<td>13.2</td>
<td>0.48 (3.6%)</td>
<td>0.07 (0.5%)</td>
</tr>
<tr>
<td>$</td>
<td>$2,200,000</td>
<td>$550,000 (25%)</td>
<td>$150,000 (7%)</td>
</tr>
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</table>

Annual per 1,000 HCWs
CSA Standards for Respirators

It’s a Different World Now.

SARS  H1N1  MERS  SARS2  ?  ?

1982...1993...2002...2011...2018...2023...2028...2033

PANDEMIC  ?  ?
Medical Masks

Particulate Respirators

Leak  Uncomfortable  Hot

Too hard to breathe through
Breathing Resistance

**Particulate**

- NIOSH: 245 Pa
- CA-N95-175: 175 Pa
- CA-N95-100: 100 Pa

**Bioaerosol**

- BA3-100: 100 Pa
- BA3-50: 50 Pa
- BA3-25: 25 Pa

Lower is better.
Bioaerosol Respirator

½ the filter material
½ the waste
Disposable

Plant-based option

BA1

<5% Leak
Disposable BA2 Plant-based option

BA2 <1% Leak
Reusable

BA3

<0.5% Leak
**Particulates**

Sharp, hard, heavy, asymmetrical
10 nm and larger

**H2H Bioaerosols**

Sticky, watery, light, spherical
300 nm and larger
Particulates

Salt  2.2 g/cm³
Mineral dust  2.6 g/cm³

H2H Bioaerosols

Latex  1.05 g/cm³
Bioaerosol  1.0 g/cm³
"85% of the total viral load was emitted in fine aerosols (≤5 µm in diameter) when compared with coarse aerosols (>5 µm in diameter), which is consistent with the observation that smaller particles (0.65–4.7 µm) account for 77–79% of total virus particles shed by experimentally infected cynomolgus macaques [15]."
H2H Bioaerosol Sizes

1. Respiratory Aerosol Emissions from Vocalization: Age and Sex Differences Are Explained by Volume and Exhaled CO2
2. Nicholas Good, Kristen M. Fedak, Dan Goble, Amy Keisling, Christian L’Orange, Emily Morton, Rebecca Phillips, Ky Tanner, and John Volckens
4. DOI: 10.1021/acs.estlett.1c00760
Proposed for 2024:

Universal Respirator Use in Healthcare Facilities (unless PCRA says not needed).

Bioaerosol Option

Consider the environment
Reusable and sustainable PPE in B.C.

IPAC Canada National Conference
Tuesday May 30, 2023
Energy & Environmental Sustainability (EES) Team

A regional collaboration team that supports low carbon, climate resilient and environmentally sustainable health-care.
Low carbon resilient and environmentally sustainable health care
Saving money and the environment

**Background**
- Fraser Health accounts for 75% of Metro Vancouver’s disposable gown consumption
- Before 2020, Surrey Memorial Hospital alone constituted 50-75% of Fraser Health’s disposable gown usage each week

**Opportunity**
- Supplement the inventory of disposable isolation gown with reusables
- Track costs and waste to measure impact

**Results**
- By February 2021 reusable gowns comprised 97% of gowns at the site
- 869,000 disposable gowns kept out of landfill
- Reusable gowns are 9 times cheaper per use, leading to $2 million of savings in 6 months.
Going the extra step

**Background**
- During the global PPE shortage in 2020, St. Paul’s Hospital needed a stable supply of surgical gowns.
- Their operating rooms were still running at full capacity and didn’t slow down like other sites.

**Opportunity**
- A local company provided a reusable surgical gown service, which St. Paul's piloted, the first site to do so in B.C.
- The gowns come from Ecotex and are sterilized on-site in the MDR.

**Results**
- The reusable surgical gowns can be used 100 times then have a new life as a non-sterile isolation gown or warming jacket.
- Reusable gowns provided a stable, reliable supply through the pandemic.
- Increased labour needs, but the benefits are huge: lower cost, lower waste, peace of mind.
Ensuring quality in the PPE Testing Lab

**Background**
- At the onset of the pandemic, there was an immediate increased demand for PPE around the world and it severely disrupted global supply chains
- Vancouver Coastal Health (VCH) recognized the need for a local lab that could quickly test and validate the effectiveness of PPE

**Opportunity**
- VCH opened Western Canada’s first accredited PPE testing lab in just a few months
- The scope of the lab now includes test methods for respirators, medical masks and gowns.

**Results**
- The lab tests PPE for multiple health care organizations and local manufacturers
- They have prevented **2.4 million** unsafe respirators and **325,000** unsafe isolation gowns from entering B.C supply chain
A better end-of-life scenario for PPE

**Background**
- Thousands of masks, gloves and other PPE are disposed of weekly in B.C.
- The Canadian federal government provided research funding opportunities throughout the pandemic for better recycling options for PPE

**Opportunity**
- In 2021, several B.C. health authorities participated in a mask recycling pilot program
- Building off the success of the pilot, the B.C. Ministry of Health announced they would fund a provincial PPE recycling program to be launched in June 2023

**Results**
- **80 sites** across the province be able to opt-in to the PPE recycling program
- PPE will be sterilized and pelletized into pellets, to be used in new plastic products
What’s coming up?

- We want to lessen the negative impact of PPE on planetary health while making the health care system more resilient.

- A Reusables First commitment will help get us there.

- We are working with CASCADES:
  - To do an organizational analysis on clinical and procurement process.
  - To co-create with IPAC a national guideline on the safe use of reusables in health care.
Let’s work together

IPAC are our partners in our work, we can’t do it without you!
Thank you!
Infection Control & Sustainability: Common Challenges, Common Goals

IPAC Canada 2023 National Conference
May 30, 2023
Ed Rubinstein is the Director of Energy & Environment at the University Health Network (UHN) in Toronto, Ontario.

His salary is supported by UHN. He has received no other funding for the research and information he will be presenting.
Infection Control & Sustainability: Myth vs. Reality

**The Myth**
Infection Control & Sustainability are always at odds with each other.

**The Reality**
There’s more in common than you think.

image source: https://en.wikipedia.org/wiki/Temperate_rainforest#/media/File:Windy_Bay_forest.jpg
"Researchers have shown that deforestation can drive outbreaks by bringing people closer to wildlife, which can shed dangerous viruses. Scientists found these dynamics can explain several recent outbreaks of Ebola, including the largest one nearly a decade ago in Guinea, which scientists believe started after a toddler played in a tree that was home to a large colony of bats. The child may have touched something contaminated with saliva or waste from an infected bat, then put his hands in his mouth, inadvertently giving the virus a foothold."
Environmental health is a human health (and Infection Control) issue

“Climate change, pollution, changes in our weather patterns, more rainfall, more closely packed, dense cities and urban areas - all of this facilitates the spread of antibiotic resistance.”
Climate change is a human health (and Infection Control) issue

“...mosquito-borne diseases are already popping up in unexpected places, a shift scientists have attributed in large part to climate change.”
Climate change is a human health (and Infection Control) issue

"...we estimate that the yearly probability of occurrence of extreme epidemics can increase up to threefold in the coming decades."
Climate change is a human health (and Infection Control) issue

“...global warming had made storms wetter and more intense than they would otherwise have been, hitting already vulnerable communities harder. That, in turn, has led to outbreaks of disease that are worse and harder to stem than would otherwise be the case...”
We want our HVAC systems to work properly: Efficiently delivered air = Healthy air

- **Calibrated** sensors (humidity, temperature, etc.).
- Clean coils, ducts and filters.
- Calibrated valves and dampers.
- Variable speed drives.
- Balanced airflows (and pressures).
- Building Automation System (BAS) connection for monitoring and control.

![Image of HVAC system](http://www.prweb.com/)
It’s not the heat, it’s the humidity.

Actually, it’s the heat too, but poor humidity control is a sign that HVAC is not working properly and can lead to:

- Complaints
- Sweating pipes and ducts…and mould.
- Increased infections

“Relative humidity maintained between 40-60% decreases airborne transmission of infectious aerosols and optimizes natural respiratory immunity of patients.”
There is such a thing as being “too clean”

“When bacteria are exposed to triclosan for long periods of time, genetic mutations can arise. Some of these mutations endow the bacteria with resistance to isoniazid, an antibiotic used for treating tuberculosis...”

“Many of these studies observed an association between a rise in triclosan exposure and reproductive and developmental defects in infants.”
We don’t like drugs going down the drain (especially in handwashing sinks)

- Contamination of natural waterways
- Health and safety risk for municipal (and hospital) workers
- Potential disruption of sewage treatment
- Potential growth of biofilms in sinks

“Drug resistance can develop naturally, but experts say the overuse of antimicrobials in people, animals and food production has accelerated the process.”
We want a safe and secure source of PPE...

"...very large demand shock triggered by acute need in healthcare and panicked marketplace behavior that depleted domestic PPE inventories."

"...encourage development, testing, and production of higher-quality, reusable PPE."
Reducing Hospital-Related PPE and Medical Single-Use Plastic Waste Through Circular Economy Practices

Presentation to Federal-Provincial/Territorial Sub Working Group on Reducing PPE Waste

July 20, 2021

Kady Cowan, Project Technical Director
Ed Rubinstein, Project Partner, UHN

...that is less harmful to the environment...

Case Study: Huge switch from disposable to reusable isolation gowns

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Results</th>
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<tbody>
<tr>
<td>Environmental results:</td>
<td>Acute Care Hospital</td>
<td></td>
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<tr>
<td>• Close to 900,000 gowns kept out of landfill/incinerator.</td>
<td>Proportion in May 2020</td>
<td>96%</td>
<td>3%</td>
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<tr>
<td>• Over $2M savings over a 6 month period</td>
<td>Proportion in Feb 2021</td>
<td>4%</td>
<td>97%</td>
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<tr>
<td>• Plus almost $50K savings from avoided waste disposal costs.</td>
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<td>Social results:</td>
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<tr>
<td>• Positive feedback from users relating to quality and comfort.</td>
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<td></td>
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<tr>
<td>• Reliable, local, sustainable supply – investing in our region.</td>
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• Per use cost for a reusable gown is approximately 9 times cheaper than the per use cost for a disposable gown.
• Positive results from users relating to quality and comfort.
• Reliable, local, sustainable supply into the future.
…but recycling alone is not the answer.

“Up to 90% of [medical] product emissions are generated during manufacturing, for which improved recycling programmes will never compensate.”
We are driven by science…

Decisions based on
✓ research
✓ data
✓ “real world” settings

THE 7 SINS OF Greenwashing
1. No Proof
   Not having accessible evidence of the environmental impact the company has
2. Vagueness
   Using labels that are ambiguous and poorly defined
3. Irrelevance
   Using labels that are insignificant to whether the product/service is eco-friendly
4. Lying
   Marketing facts that aren’t true
5. Hidden Trade Off
   Advertising only a small set of attributes and not the whole picture
6. Worshipping False Labels
   Creating fake certification labels or endorsements from a third-party
7. Lesser of 2 Evils
   Comparing products to be greener when they are all non eco-friendly

Source: EcoWatch

image source: https://theolivetreeproject.com/what-is-greenwashing/
...to get people to do what they already know they should be doing...
...but are challenged by misinformation...

“...concept that has been massively distorted online...”

“...speaker this night believes a hidden agenda is at play...”

“...a small minority...that [are] increasingly vocal...”
...in emotionally charged subjects.

<table>
<thead>
<tr>
<th>Myth</th>
<th>Reality</th>
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<tbody>
<tr>
<td>All hospital waste is “infectious”.</td>
<td>Less than 10-15% of hospital waste requires treatment.</td>
</tr>
<tr>
<td>Isolation room waste is “infectious”.</td>
<td>Routine precautions required for collection and handling, but treatment usually not required.</td>
</tr>
<tr>
<td>You can’t recycling in Operating Rooms.</td>
<td>You can!</td>
</tr>
<tr>
<td>Recycling food containers and composting attracts bugs.</td>
<td>Improper cleaning attracts pests.</td>
</tr>
</tbody>
</table>
We know that it’s better to design it right in the first place (but sometimes we’re late to the party)

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spaces that are easier to clean.</td>
<td>Less chemicals for cleaning.</td>
</tr>
<tr>
<td>Process and spaces that fit clinician workflow.</td>
<td>Lower chance for &quot;mistakes&quot;.</td>
</tr>
<tr>
<td>The “right” stuff:</td>
<td></td>
</tr>
<tr>
<td>• Smaller, modular pumps, etc. with N+1 redundancy.</td>
<td></td>
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<tr>
<td>• Variable speed drives.</td>
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<tr>
<td>• Fewer unplanned downtimes.</td>
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<td>• “Soft” start.</td>
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<tr>
<td>• Energy efficient.</td>
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Hierarchy of Controls

- Elimination: Physically remove the hazard
- Substitution: Replace the hazard
- Engineering Controls: Isolate people from the hazard
- Administrative Controls: Change the way people work
- PPE: Protect the worker with Personal Protective Equipment

Image by NIOSH
[https://www.cdc.gov/niosh/topics/hierarchy/default.htm/](https://www.cdc.gov/niosh/topics/hierarchy/default.htm/)
We both dislike nosocomial infections

Sustainability is not about “saving the planet”, it’s about preserving human health and quality of life.
Thank you

Ed Rubinstein
Director, Energy & Environment
University Health Network

edward.rubinstein@uhn.ca

A Healthier World Through A Sustainable Environment

https://talkintrashwithuhn.com/
Saving the world with the right PPE

Dr. Joe Vipond
May 30th, 2023
IPAC Canada Conference.
Conflicts of Interest

None declared
Which change in masking use would make the most impact on the hospitals GHG footprint?

- A. Switching to plant-based mask filters
- B. Switching to reusable elastomeric respirators
- C. Using a respirator-style mask instead of a surgical mask for an airborne virus
- D. Using as few masks as possible
- E. Sourcing masks from a local manufacturer
Using a respirator-style mask instead of a surgical mask for an airborne virus

Correct answer: C
Bob is a 72 M in hospital for a hip replacement

A retired firefighter, he wants to be more mobile so that he can continue hiking with his 3 children and 8 grandchildren.
Four Statements of Truth

1. COVID is Airborne
2. Aerosols are generated by many activities, including breathing and talking
3. At least 50% of infections come from asymptomatic patients
4. COVID HAIs are preventable
Postop, Bob is sent to a four person room with curtains separating each patient. Two of his roommates are also recovering from ortho surgery, awaiting placement in LTC. One has early dementia and is prone to wandering.
COVID is Airborne

1. Superspreading events
2. Long range transmission
3. Asymptomatic spread
4. Safer Outdoors
5. HAIs despite C/D PPE
6. Aerosol Detection
7. Sampled in air ducts
8. Animal studies
9. No evidence against
10. No evidence for C/D
Bob’s Roommate, Ralph, has a bunch of visitors over for an hour on POD 1.

Ralph’s 23 year old daughter, Jennifer, is here three days after a wedding where, unbeknownst to her, she was exposed to covid.
Asymptomatic Spread

This is the key difference between SARS-CoV1 and SARS-CoV2.

50% of infections come from people that have no symptoms (asymptomatic or presymptomatic).
Aerosol Generating Behaviours
POD 3: Scheduled to go home, Bob gets a fever, has a cough, and is increasingly weak.

A PCR test is +ve for COVID. He can no longer participate in rehab activity and is essentially bedridden.
HAIs are still occurring

Reporting in BC?
In ON?
In UK:
POD 12: Recovered from COVID, recovered from surgery, Bob is sent home.

9 days later than expected, and behind on his rehab schedule.
Pre-Omicron:

HAIs had 39-42% CFR Vs. 25% for hospitalized community acquired

DOUBLING of risk for immunocompromised HAIs
CFR of HAI COVID

Pre-Omicron:
-HAI's had 39-42% CFR
-Vs. 26-35% for hospitalized community acquired
-DOUBLING of risk for immunocompromised HAI's

Post- Omicron:
-8.4% CFR (Nov '21-Apr '22)
-10.6% CFR vs 7.4% Non-HAI (2022)
Other Outcomes of COVID HAIs?

Increased duration of hospital stay?
One study: 27 days vs 16 days for NHA COVID
-no comparison for equivalent hospital admit
   (hip surgery w/ HAI vs. hip surgery)

Increased risk of readmission?
-significant increase 15% vs. 4% (in first wave)
Becky, an RN on Bob’s ward, gets COVID from caring for him.

She has a significant risk of longCOVID, and therefore worsening the nursing staffing crisis.
Risk of LongCOVID

StatsCan Data released Oct ’22
-postOmicron: 10.2% incidence

At higher risk:
- females
- health care staff
- higher severity of initial infection
What does this have to do with Greening Health Care?

Hospitalization costs $$ and Energy and creates waste!

**ACUTE CARE:** 5.5 kg of solid waste and 45 kg CO$_2$-e per hospitalization day

**ICU CARE:** 7.1 kg of solid waste and 138 kg CO$_2$-e per bed day

**Disabled staff:** ????? Cost to society
We can prevent COVID HAIs

01 Mask Mandates
Shared understanding of the problem and expectations

02 Improved Ventilation
Ensuring 13+ Air Changes/hour in all spaces

03 Adding Filtration
Adding HEPA filters to areas with inadequate ventilation

04 Respirator mask use
Respirator masks are designed as PPE for airborne protection
## CONTACT

<table>
<thead>
<tr>
<th>Twitter</th>
<th>@jvipondmd</th>
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</thead>
<tbody>
<tr>
<td>Website</td>
<td>cape.ca</td>
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<tr>
<td>EMAIL</td>
<td><a href="mailto:jvipondmd@gmail.com">jvipondmd@gmail.com</a></td>
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