

Respiratory illness linked to poor air quality at an indoor ice arena



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BCM J

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ON THE COVER

Respiratory illness linked to poor air quality at an indoor ice arena

A recent case of respiratory illness following a hockey practice in Kelowna spurred an investigation that revealed toxic levels of carbon monoxide, nitrogen dioxide, and particulate matter in the arena due to a confluence of contributing factors. Article begins on page 50.

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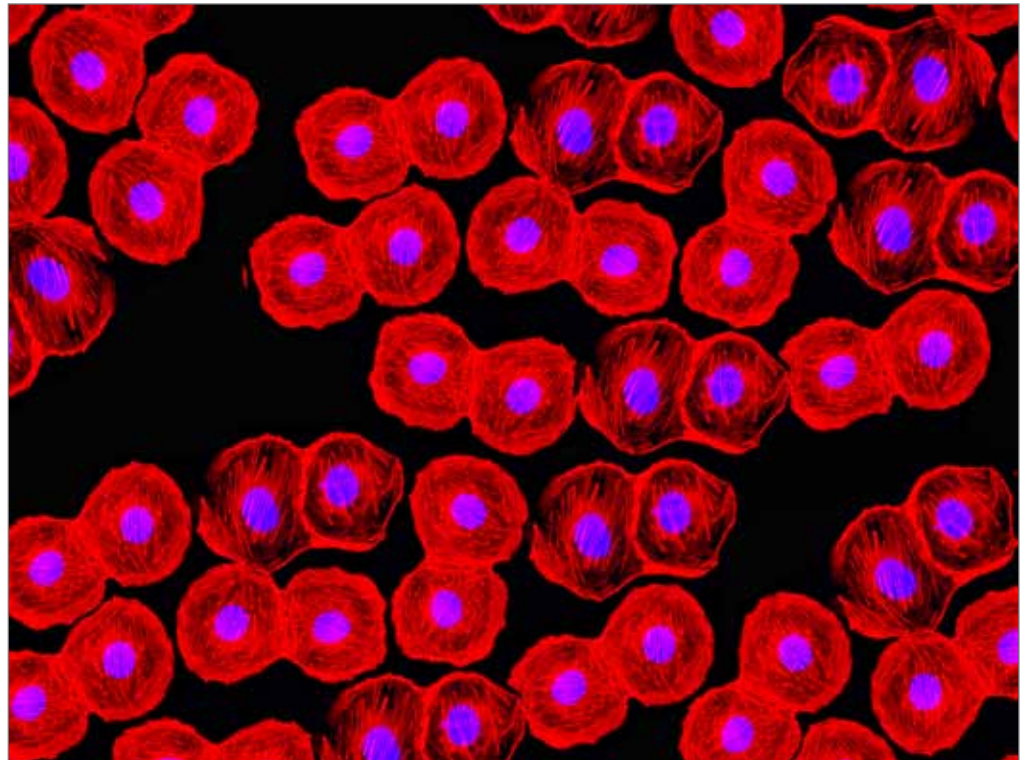
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Scents and sensibility

I t's 2020 and I'm wearing perfume. I wear Very Irresistible by Givenchy. Very irresistible to some but apparently toxic to others.

It took an incident at a friend's house to make me realize the effects that fragrances can have on some individuals. I went to spend a weekend with my friend, and on day 1 everything was great, but on day 2 I awoke to a chill in the air. It was a crisp January morning and my friend had opened all the doors to her home. She had developed a cough, headache, and mild nausea in response to my perfume. She told me that this was a common occurrence for her.

I've also had patients complain of being sensitive to scents in their work environments, some to the point of opening WorkSafeBC claims. I've always advocated for my patients but have questioned the validity of such claims.

The word *perfume* derives from the Latin word *perfumare* meaning "to smoke through." The art of making perfume began in ancient Egypt and China and was refined by the Romans and the Arabs. Apparently all public places in Britain were scented during Queen Elizabeth I's rule (1558–1603) as she could not tolerate bad smells. The first scented colognes were brought to America by French explorers. As of 2019, the global fragrance market was estimated to be worth approximately US\$38 billion—expected to rise to over US\$50 billion by 2025.

Perfume is a mixture of fragrant essential oils or aroma compounds, fixatives, and solvents used to give the human body, animals, food, objects, and living space an agreeable scent. There has been limited information available about the safety of fragrance compounds as the manufacturers are not required to—nor do they want to—elaborate on the ingredients of fragrance mixtures, which are classified as trade secrets. The FDA controls the safety of fragrances through their ingredients and requires that they meet the designation of "generally recognized as safe" (GRAS). The International Fragrance Association is one of the governing bodies attempting to produce guidelines with the aim of safe production and

use of fragrances. The association can outright ban certain fragrances or conduct risk assessments for potential adverse health effects.

There have been numerous studies done to evaluate the health effects of fragrances. An article in *Environmental Research*, "Neurotoxicity of fragrance compounds: A review,"¹ states that most fragrance compounds belong to one of three families: phthalates, synthetic musks, or chemical sensitizers. Phthalates enable the slow evaporation of the fragrance allowing the scent to linger longer. Various studies have shown adverse effects of phthalates, such as endocrine disruption, bone mineral density decline, sperm dysfunction, and neurotoxicity even at the

perinatal level. Fragrances usually fall into the category of synthetic musks. There are four main groups of synthetic musks, and the newer polycyclic musks are the most popular, but there are still questions about their safety, specifically concerning estrogenic agonism and a possible increase in the proliferation rate of human breast cancer cells. These compounds have also been shown to accumulate in the environment and their biodegradability is questionable. The authors summarized that while we have considerable data on the role of fragrance compounds and their general toxicity, and more specifically endocrine disruption, less is known about their neurotoxicity. The extent to which these compounds are found in consumer products also remains a mystery due to lack of research and deficient regulation. The authors recommend additional studies elucidating the neurotoxicity of fragrance compounds.

The authors of an article in *Clinical and Experimental Allergy*, "Increased release of histamine in patients with respiratory symptoms related to perfume,"² concluded that perfume induces a dose-dependent non-IGE mediated

release of histamine from human peripheral blood basophils. This increased basophil reactivity to perfume was found in patients with respiratory symptoms related to perfume but the mechanism causing the increased reactivity was not known. This study was limited by its small sample size.

Regulatory Toxicology and Pharmacology cites a paper from 2019, "Fragrance inhalation and adverse health effects: The question of causation."³ The authors state that although some fragrances have the potential to cause skin sensitization, they lack the ability to induce allergic sensitization of the respiratory tract. They suggest that it is possible for asthmatics and other suscep-

tible individuals to have an exacerbation of their respiratory symptoms when exposed to fragrances, but this would be more in keeping with an irritant effect of high levels of exposure to the causative agent coupled with the higher sensitivity of the exposed individual. They state that the key feature of a commercially successful fragrance is that it stimulates olfactory receptors at low concentrations and some individuals may link these olfactory triggers with adverse effects, including respiratory responses. They were unable to find a causative explanation in terms of allergy or irritation and suggested that a neurological/psychological mechanism may be involved. They felt that it was unhelpful to heighten consumer fears by unwarranted conclusions drawn from questionnaire studies with methodological weaknesses.

I was unable to find any robust studies linking exposure to fragrances with adverse health effects. I believe research still needs to be conducted in this area, especially to develop validated diagnostic toxicological tests to evaluate fragrances.

The extent to which these compounds are found in consumer products also remains a mystery due to lack of research and deficient regulation.

Human nature in times of stress

And I've decided that I need to be sensible when it comes to wearing scents. I have stopped wearing perfume to work or in any situations that will involve close interactions with others. I'll reserve being very irresistible for hot nights in the city. ■

—Jeevyn K. Chahal, MD

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A few months ago, I read something about the severe acute respiratory syndrome (SARS) outbreak of 2003 and I remember thinking, it's only a matter of time until something else strikes. In case you think I have some prophetic power, I should state that I have never won a lottery prize.

As I write this editorial in early February, the novel Wuhan coronavirus has been declared a world health emergency by the World Health Organization. At this point, there have been about 14 000 documented cases in 23 countries with over 300 deaths, all but one in China. It remains unclear if this virus is destined to become a global pandemic or fizzle out in the months to come.

Fortunately, this virus appears to be less virulent than SARS, which had a death rate of roughly 10%. However, it is much more

contagious and is already close to doubling the number of SARS cases. Also troubling, and making screening more difficult, is the virus's apparent ability to transmit prior to an individual being symptomatic. I am reminded of the Spanish flu outbreak in 1918 (no, I'm not that old), which had a lower mortality rate than SARS but by the sheer number of people infected was responsible for millions of deaths.

By the time this editorial makes it to print, the trajectory of the Wuhan coronavirus will likely have been decided. The purpose of my editorial is to reflect on human nature and the hope I have for compassion and grace. It is easy to be a positive influence in the world when everything is going well. Sadly, I have found that true human nature is often demonstrated during times of stress and difficulty. Sporadic reports of racism directed toward the Asian community have already begun to surface. Viruses don't care about human skin pigment or geographic origin. This virus could have just as easily originated in a town or city on any other continent.

I have fielded a few questions about this novel virus in my office, and I can feel the fear building among my patients. I remain hopeful that despite the challenges this virus might bring that the world will react with decency toward those less fortunate. Now don't get me wrong, I don't want my family or friends to be infected, and I'm not immune to the anxiety this potential pandemic might bring, but I will strive to focus on the caring our profession is known for. Increasingly, we live in a closely connected global society, so this situation affects all of us. I will strive to do my part with empathy and respect when faced with any threats this virus might bring. May the world do the same. ■

—David Richardson, MD

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Amplifying value

“Don’t it always seem to go,
that you don’t know what you’ve got
‘til it’s gone.”

—Joni Mitchell

The practice of medicine is evolving at a pace unimaginable in previous times. As this evolution unfolds, we need to take a hard look at the basic tenets of care that, as health care providers, we want to keep and work diligently to maintain, while acknowledging that this likely means excluding other diagnostics or treatments.

Right now in BC the strongest movement afoot is team-based care. This model has been shown to improve access, freeing up physicians to deliver services that only they can deliver. We know longitudinal, community-based care reduces hospital and ER admissions, removes duplication of services, and saves the system money. While the power of longitudinal care lies in the core relationship between the provider and the patient, we need to ensure the care coordination piece is well supported. It takes time to collaborate and build treatment plans across areas of practice to improve the patient’s journey and outcomes. That said, our metrics and models of payment are not developed enough to fully capture the value of this type of care in terms of future costs avoided. The value-add evidence is not apparent to the general population.

Increased use of remote telemedicine or virtual care has transformed the way patients may seek and receive care. While remote access to telemedicine makes sense for those who would otherwise have to leave their community to seek care, what happens as health care becomes more consumer-led? Does access to medical services delivered from the phone in your pocket, at any time of day, devalue those providing the long-term committed care? I would say yes. Does the ability to instantly rate or critique the services you receive the same way you evaluate

the shop that changes your tires lead to devaluation? Yes. In some communities, social media has been used to aggressively blame and shame health care services in a way that is leading to the societal distrust and devaluation of physicians’ knowledge and skillsets. It is difficult to remain dedicated in an often toxic environment. We need to remind our communities that they truly “don’t know what you’ve got ‘til it’s gone.”

Amplifying the value that physicians bring to the health care system is challenging for a number of reasons. Patients are constantly bombarded with conflicting information about best practices, the latest technologies, or procedures from multiple sources, including expanding global social media and celebrity-driven discussion forums. Although patients want to participate more actively in their own care, providers are often not allowed funded time to have the related discussions—discussions that ensure the care provided is the most appropriate, guideline-driven plan for each individual patient. Neither party walks away from these situations feeling well served.

As the practice of medicine evolves, funding for supports and payment model options needs to keep pace. These systems must reflect the change in how patients want to receive care, and the way in which physicians deliver that care. For instance, do we continue to value episodic or procedural treatments above longitudinal care when we know that episodic care drives use and costs? Do we continue to fund a universal level of basic, evidence-driven medicine,

or cater to the will of the individual seeking access to maximal everything for every ailment? Depends on who you talk to. Virtual episodic care is much more likely to address the latter. Current funding models leave those physicians dedicated to longitudinal care struggling to keep the lights on while striving to remain healthy and engaged.

As I have traveled around the province listening to the needs of patients, physicians, and health care management groups, it has become apparent there are gaps—gaps in understanding on both sides of the equation about how more innovative funding and payment models can enhance care delivery. The current situation has been described as the Wild West. No single

**As the practice of
medicine evolves,
funding for supports
and payment model
options needs to
keep pace.**

payment model is perfect, or a fit for every physician, at every stage of their career, or even within the same section. Certain workflow expectations may seem reasonable to physicians or administrators, yet be untenable to others for unforeseen reasons. Where there is a knowledge gap, confabulation and presumption fill the void. Rumor and unfounded assumptions abound.

For our health care processes to remain sustainable and meet the needs of patients, administrators, and physicians, we need to listen to all perspectives. We must work collaboratively to build models of compensation and workload expectations based on the shared understanding of the short-, medium-, and long-term vision for care delivery in each region. We must establish a shared responsibility for cost containment and

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Letters to the editor

We welcome original letters of less than 300 words; we may edit them for clarity and length. Letters may be emailed to journal@doctorsofbc.ca, submitted online at bcmj.org/submit-letter, or sent through the post and must include your mailing address, telephone number, and email address. Please disclose any competing interests.

Re: The age of mushrooms is upon us in medicine

Thank you to Dr Mark Elliot for his article outlining the potential benefits of psychedelic compounds now being studied in certain disciplines of medicine and cognitive therapy [*BCMJ* 2019;61:390-391]. While our colleagues in cardiovascular medicine, oncology, and surgery seem to have enjoyed significant advances in their respective fields, the same cannot be said of those involved in treating depression, addiction, and PTSD, and those working in palliative care.

We share Dr Elliot's enthusiasm for the potential benefits of these therapies, but also wish to issue a reminder that as we proceed with an open mind we should also remain highly critical. The medical community must not legitimize unfounded theories, and must ensure that any future studies of these compounds abide by the scientific method and prioritize the safety of our patients.

These promising therapies are sure to come under scrutiny by many, both inside and outside the medical community. With this being said, we question Dr Elliot's mention of the Stoned Ape Theory first postulated by Terence McKenna and more recently propagated by Paul Stamets on the popular podcast *The Joe Rogan Experience*. Mr Stamets, a mushroom enthusiast, seems to have one foot in the field of mycology as a science and the other in the realm of unfounded and seemingly far-fetched theories. The Stoned Ape Theory postulates that during human evolution our primitive ancestors consumed mind-altering mushrooms, the effects acting as an evolutionary catalyst, supposedly responsible for the higher-level development of language, religion, and music. We, the authors of this letter, have no formal training in mycology or anthropology, but from our brief

reading, this theory appears to have no credible evidence to support it and has actually been heavily criticized by the scientific community.

The long-running stigma associated with these psychotropic compounds is in part a reaction to the ardent promotion of pseudoscience by advocates such as Timothy Leary. If these compounds are to be incorporated into mainstream medicine, we owe it to our colleagues and especially our patients to present accurate findings and reject unsubstantiated claims. It is critical that we separate the potential medicinal benefits of these compounds from the cultural and societal biases with which they are often associated.

—Chris Little, MD, FRCPC
Penticton

—Edward Brooks, MD, FRCPC
Victoria

Author replies

I couldn't agree more with your cautionary note. Paul Stamets seems to be an extraordinary mycologist with dozens of patents to his name, but with enough publicity people like him can easily become gurus, which is not good. I mentioned the Stoned Ape (Stone Age in his original article) hypothesis only because it is an interesting theory. Whether one day some experiment will come up with an observation to back it up is doubtful. This is a problem in many areas of science dealing with fundamental issues. But as Karl Popper said, "All observation is theory laden," which means nature (theory) proposes and the environment (observation from experiment) disposes, which is just stealing another well-known saying from genetics. We will see where it leads.

—Mark Elliott, MD, FRCPC
Vancouver

Re: The age of mushrooms is upon us in medicine

I was pleased to see the *BCMJ* publish Dr Mark Elliott's piece, "The age of mushrooms is upon us in medicine." Psychedelics such as LSD and psilocybin showed great promise as investigational tools and, in the case of LSD, as a treatment for addiction, until politics and irrational fears essentially ended all research into these agents for decades. Fortunately, this is changing and a number of studies, as imperfect as they are, suggest that psychedelics, combined with appropriate psychotherapy, may hold great promise in treating end-of-life anxiety, depression, and addiction.

Dr Elliott incorrectly states that psychedelics "seem to affect serotonin and/or monoamine oxidase (MAO) receptors in the brain." MAO is not a *receptor* but rather an *enzyme* that is widely distributed throughout the body (including the CNS). It is generally agreed that the actions of psychedelic agents are primarily mediated through agonism at the 5-HT_{2A} receptor (a class of serotonin receptor) in the brain. I suspect that Dr Elliott was referring to ayahuasca, a plant-derived psychoactive brew containing *Banisteriopsis caapi* and DMT containing vines (such as *Psychotria viridis* or *Acacia sp.*). *B. caapi* contains natural MAO inhibitors that may have some minor CNS effects but act primarily by preventing metabolism of DMT in the gut. This allows the DMT to be absorbed and to exert its effects on the CNS.

Thank you for publishing this otherwise excellent brief overview of the emerging field of psychedelic medicine.

—Jeffrey Eppler, MD
Kelowna

Author replies

Thanks for pointing out my error about monoamine oxidase being an enzyme rather than a receptor. As a practising anesthesiologist I don't pay as much attention to pharmacological acronyms as I should. Psychedelics *may* be helpful for treating opioid addiction, but it will be a small percentage of patients who will be cured. Going this psychedelic route is worth a shot when you look at our failure with how we

LETTERS TO THE EDITOR

handle the problem now, whereby a drug user gets an unknown white powder, which could be fentanyl or heroin at markedly different LD50s, and that is 90% contaminants, which is then shoved into the right side of the circulation with horrific vascular/septic results. If the drug was clean and the dosage known there would be very few of these patients showing up in the operating rooms, but this is a political, not a medical issue.

Microdosed psychedelics might become a standard anesthetic preoperative medication someday.

—Mark Elliott, MD, FRCPC
Vancouver

Doctor shortage

The current family doctor shortage is a crisis. It is especially bad where I live, in Parksville on Vancouver Island. Why has the situation become so dire? In my opinion, it has happened because of gross incompetence at multiple levels of the medical profession and government. I am a retired family physician. I am a UK graduate. I was in full-time family practice in Alberta for 6 years and BC for 28 years before semi-retiring to Parksville in 2012, where I worked as a rural locum and urgent care physician part-time until I fully retired from practice in 2016, aged 69, after 46 years of medical practice. As far back as the late 1980s and early 1990s, it was well known that the average age of family physicians in BC was in the 50s. It was becoming clear to us practising family doctors that the family practice model we were all working in was becoming less attractive to the next generation of doctors, who were able to work in walk-in clinics, where they could see large numbers of people with relatively minor complaints and would not have to become involved with older patients with more chronic complaints, who require care on a more longitudinal basis. Since then, the Medical Services Plan has made changes to increase the payments for older patients with chronic conditions, which certainly helped, but none of the changes have turned the tide to attract more young physicians to enter full-time family practice. In the mid-2000s one of my partners tragically died in his early 60s of cancer. We were unable to

find anybody to take over his extremely large practice consisting mainly of older patients. The only way I could not leave my own patients in the lurch when I retired from my practice was to move my charts and practice to a clinic that was a hybrid walk-in family practice, which took over all my charts so I could walk away.

I believe that action should have been taken over 20 years ago, which may have prevented the crisis we find ourselves in today. Full-service longitudinal family practice needs to become more attractive. Many young physicians do not relish the thought of running a small business, which means acquiring somewhere to develop a medical office, employing staff, ordering supplies, and paying a mortgage or rent, just to mention some of the expenses involved. It appears that many young physicians prefer to work under a different model, such as a salaried system with good benefits, vacation time, and paid continuing medical education in a team-based model with nurses, social workers, and other support workers under the same roof. This model has been shown to be successful in many parts of Canada.

The government and the profession must work harder to find ways to provide every citizen access to a local family physician. It does not appear that this is happening now. Clearly, inadequate numbers of family physicians are being trained, and the trained physicians are not coming to places like Parksville or Qualicum. It is difficult for young physicians who trained overseas to return to Canada, their home, to practise here. Canada is not providing enough places in medical schools to maintain the supply of physicians that the country requires, which is one of the reasons many young Canadians go overseas for their medical education.

Parksville is experiencing a building boom, and in a few years, there will be thousands more people living here. Who is going to look after all of us?

—Jonathan M. Winner, MD
Parksville

PRESIDENT'S COMMENT

Continued from page 46

access to appropriate, equitable, culturally safe, timely care. The general population should be made aware of what services, on what timeline, a publicly funded health care system can deliver so they can adjust their expectations.

If British Columbians and our governing bodies are to maximally benefit from the unique knowledge and skillsets physicians bring to the table, then payment models should universally incorporate time for teaching, multidisciplinary simulation training, research, quality improvement endeavors, evaluation, and participation in health care system management.

I believe that with ongoing open dialogue, visioning, and collaboration, we can continue to build a health care system that is sustainable and meets the needs of patients, care providers, and administrators alike. We need commitment on all sides of this shared responsibility to bring this to life. ■

—Kathleen Ross, MD
Doctors of BC President



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Cluster of respiratory illness in British Columbia linked to poor air quality at an indoor ice arena: A case report

An example of the importance of health care providers reporting disease clusters to public health authorities.

ABSTRACT: In February 2019, a 56-year-old male was admitted to Kelowna General Hospital with a respiratory illness following recreational hockey practice at an indoor ice arena. During his hospitalization, he disclosed that several of his hockey teammates had similar respiratory symptoms. This prompted the hospitalist physician to contact an Interior Health medical health officer regarding a potential cluster of respiratory illness. The investigation that was launched found toxic levels of carbon monoxide, nitrogen dioxide, and particulate

matter had accumulated in the indoor ice arena. Numerous contributing factors were identified, including the use of older-model ice resurfacing and edging equipment, the unseasonably cold outdoor weather conditions at the time, and the failure of heating, ventilation, and air conditioning equipment. This case report highlights the importance of health care providers reporting disease clusters to public health authorities, even when the causative agent may not be reportable under the British Columbia Public Health Act.

Case data

On 12 February 2019, a hospitalist physician at the Kelowna General Hospital contacted the Interior Health on-call medical health officer (MHO) to report a cluster of respiratory illness.¹ A 56-year-old male had been admitted to hospital with acute respiratory distress on 9 February after playing hockey on 8 February at an indoor ice arena. While recovering in hospital, the patient disclosed that several fellow players had developed respiratory illness with similar symptoms on 8 and 9 February.

A cluster investigation team was struck immediately to determine if the players had been exposed to a disease-causing agent. The team was led by an Interior Health MHO and included three environmental health officers, a communicable disease specialist, and an epidemiologist. The team developed case definitions

[Table] and performed a descriptive analysis of data collected from interviews and medical records. In addition, the team conducted environmental inspections of the arena.

The Interior Health team learned that after 16 players attended a hockey practice on 8 February, 12 reported becoming ill (attack rate: 75%). The team interviewed 11 of the 12 players; 1 player was out of the country and could not be reached. Of the 11 players interviewed, all were nonsmokers and none reported any recreational drug use. The age range of those affected was 35 to 58 years (mean 52 years).

The most commonly reported symptoms were shortness of breath (91%), followed by cough (64%) and hemoptysis (36%). Of the 11 individuals interviewed, 5 (45%) sought medical care and 4 (36%) obtained chest X-rays within 24 to 72 hours from the onset of symptoms. Of the individuals who obtained chest X-rays, 3 (75%), including the patient in the index case, had a hazy lung lesion of increased density, which the radiologist reported as a patchy ground-glass nodularity in pulmonary airspace.

The patient in the index case was the only player to require hospitalization, with an initial presumptive diagnosis of community-acquired atypical pneumonia. The patient's blood cell count was normal and his chest X-ray showed patchy multifocal airspace disease most prominently involving the upper lung zones

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This article has been peer reviewed.

bilaterally. Follow-up chest X-rays showed rapid and significant improvement, and the patient was fully recovered by the time of discharge on 13 February. Nasopharyngeal swabs were negative for influenza and respiratory syncytial virus. Multiplex nucleic acid testing (NAT) was negative for viruses and bacteria. Sputum culture was negative for tuberculosis after a 6-week incubation.

An inspection of the arena building and ice rink on 12 February found a number of issues. The ice resurfacing machine was in poor repair, the HVAC (heating, ventilation, and air conditioning) system was malfunctioning, and two rooftop fans for the furnace and make-up air were not working. Data from real-time air quality monitors were not available. The West Kelowna Fire Department and Fortis BC also inspected the arena on the evening of 12 February and at the time of their inspection were unable to detect any noxious gases. However, subsequent air monitoring on 4 March by Technical Safety BC (previously BC Safety Authority) identified levels of carbon monoxide (CO) well above the safety threshold, particularly near the ice surface where a four-cycle gasoline-powered edging machine was operating in idle mode.

Arena staff reported that on 8 February significant ice maintenance had been conducted from 8:15 a.m. to 2:00 p.m., with the ice resurfacing machine operating for about 3.5 hours. A gasoline-powered ice edging machine was also used at this time. Rink operators recalled that on 8 February the weather was unusually cold for the Central Okanagan at -21 °C, which led to the bay door for the ice resurfacing machine being closed during maintenance on this particular day. None of the staff members who worked that day had respiratory symptoms. Of interest, the first player to arrive at the arena on 8 February noted that he saw a yellow haze on the surface of the ice and around the ceiling lights. None of the other players interviewed reported seeing this haze.

Discussion

Poor indoor air quality at indoor ice arenas is known to be a source of health complaints.²⁻⁹

Ice rinks at indoor facilities are typically cleaned and smoothed by ice resurfacing and

TABLE. Case definitions.

<p>Confirmed case</p>	<p>Any person present at the indoor ice arena and surrounding area on 8 February 2019 experiencing respiratory illness symptoms on or after that date:</p> <ul style="list-style-type: none"> • New or worsening cough <p>and</p> <ul style="list-style-type: none"> • Additional respiratory illness symptoms (may include shortness of breath, hemoptysis, dizziness, headache, and/or fever) <p>and</p> <ul style="list-style-type: none"> • Abnormal chest X-ray results
<p>Probable case</p>	<p>Any person present at the indoor ice arena and surrounding area on 8 February 2019 experiencing respiratory illness symptoms on or after that date:</p> <ul style="list-style-type: none"> • New or worsening cough <p>and/or</p> <ul style="list-style-type: none"> • Additional respiratory illness symptoms (may include shortness of breath, hemoptysis, dizziness, headache, and/or fever)

edging machines. Ice resurfacing machines or resurfacers are primarily fossil-fueled vehicles for maintaining the entire ice surface and are commonly referred to as Zambonis, regardless of brand or manufacturer. Ice resurfacers are used together with ice edgers, which shave and level the edge of the ice rink near the surrounding boards. Edging usually takes place once daily or every other day and is typically followed by ice resurfacing; however, ice resurfacing can take place independently of edging and is commonly done more frequently—as often as every hour.²

Air pollutants

Older models of ice maintenance equipment operate using an internal combustion engine fueled by either propane or gasoline, which can produce high levels of air pollutants, including carbon monoxide, nitrogen dioxide (NO₂), and ultrafine/fine particulate matter.³⁻⁵ Studies comparing outside air with air inside arenas that use ice resurfacing machines powered by fossil fuels have found a 60-fold to 300-fold increase in CO, a 10-fold increase in NO₂, and a 20-fold increase in small particulate matter.⁶⁻⁸ These contaminants can result in significant health risks.⁵

High concentrations of CO and NO₂ have been found in individuals who spend time in indoor ice arenas, including workers and hockey players.^{4,8,9} Carbon monoxide poisoning

produces a variety of symptoms, including headache, malaise, nausea/vomiting, and dizziness.^{10,11} Signs and symptoms of nitrogen dioxide poisoning are primarily respiratory related, including cough, hemoptysis, throat irritation, dyspnea, and chest pain.^{4,6,12,13}

Indoor ice rinks are used most commonly for hockey, ringette, figure skating, and general recreation.³ During these exercise-related activities, participants increase their respiratory rate and risk inhaling more toxic gases and particulate matter, if present.⁴ Compared with carbon monoxide uptake at rest, carbon monoxide uptake during exercise can increase up to 400%.¹⁴ Furthermore, individuals exercising on an ice rink are near the cold ice surface where less-effective mixing of combustion emissions occurs with the warmer air above.¹⁵ This puts athletes or recreational users at the highest risk for toxic exposure.^{3,4,6,9} Those especially at risk for developing complications from inhaling CO, NO₂, and particulate matter are children, pregnant women, and individuals with pre-existing cardiovascular or respiratory conditions such as congestive heart failure or asthma.^{8,9}

Factors influencing pollutant levels

The construction of the indoor ice arena can influence pollutant levels. Arenas with poor ventilation, including inadequate natural ventilation or inadequate mechanical ventilation, as

well as arenas with mechanical failure of existing ventilation systems, have increased levels of ambient CO and NO₂.¹⁶ Furthermore, the size of an arena can influence pollutant levels, with smaller arenas having higher NO₂ levels than larger arenas.¹⁷ Ice surfaces used for hockey have boards taller than many young skaters, thereby trapping the heavier-than-air NO₂ within this cooler dense air environment above the ice surface at the inhalation height of many youths. Far worse consequences could have resulted if children rather than adult males had entered the ice surface immediately after this prolonged ice maintenance activity.

In this particular cluster of respiratory illness, a number of factors likely contributed to poor air quality. Doors closed because of unseasonably cold weather conditions, prolonged ice maintenance, and HVAC equipment failure created the perfect storm opportunity for toxic levels of CO, NO₂, and particulate matter to accumulate indoors. The higher respiratory rate of players during exercise increased their exposure to pollutants over that of staff who did not report symptoms.¹⁴

Carbon monoxide and nitrogen dioxide emissions result when fossil-fuel-powered engines are used.³⁻⁵ Ways to prevent or minimize emissions include decreasing the time a fossil-fuel-powered ice resurfacing machine is in operation indoors,⁴ ensuring adequate ventilation to prevent buildup of toxic gas, and transitioning to electric ice resurfacing machines, although this last strategy can be cost prohibitive. Other solutions include manually running the ventilation system longer, opening doors during resurfacing, and ensuring that the ventilation system is working properly. Interestingly, shortly after the incident, the two (and only) ceiling exhaust fans were repaired and deemed to be functioning properly. However, many months later it was discovered that the air ducts had been intentionally blocked, most likely for energy conservation purposes. Therefore, the fans were not performing their designed task until the blockages were removed.

Studies show that CO levels are highest during the use of an ice resurfer and immediately afterwards,⁵ suggesting that arenas should use the ventilation system throughout the procedure and after resurfacing has been completed.

As well, the machines should be stored in a well-ventilated part of the arena with direct access to the outdoors or an exhaust hose to extract and redirect the fumes outside.

Monitoring

The incident described in this case report highlights the importance of real-time air quality monitoring in indoor ice arenas and the need to follow administrative protocols such as proper ventilation maintenance. While monitoring compliance with safety standards at indoor ice arenas is the shared responsibility of employers, local governments, and Work-SafeBC,¹⁸ a national or provincial guideline on acceptable levels of CO and NO₂, including protocols to mitigate toxic gas levels, could help maintain public safety. Of note, during the winter of 2020–21, Health Canada will be testing the efficacy of two interventions on air quality at indoor ice arenas, one in Ontario and one in Saskatchewan.¹⁹ The impact of fuel type on CO and NO₂ concentrations will be assessed and the efficacy of various ventilation strategies on CO and NO₂ concentrations will be quantified. The impact of other factors on indoor air quality will also be studied, such as arena volume, number of ice resurfacings, temperature, and relative humidity.

Reporting

The case study described here illustrates the importance of promptly reporting clusters of respiratory illness to an MHO. The BC Public Health Act (Section 10, Mandatory reporting of infection or exposure) requires that health care providers notify an MHO if they have reason to believe a patient is infected with a reportable communicable disease.²⁰ This includes suspected food or waterborne illnesses as well as clusters of gastrointestinal illness, as detailed in the Reporting Information Affecting Public Health Regulation. While a communicable disease was initially suspected in the index case, a prompt and thorough cluster investigation pinpointed

a chemical exposure as the most plausible cause, allowing the MHO to make recommendations to mitigate the ongoing risk at the arena.

While suspected food or waterborne illnesses or clusters of gastrointestinal illness are reportable in BC, there is no requirement to report illnesses with causes other than those listed in the regulation as “prescribed” infectious or hazardous agents. Therefore, a health care provider could be dealing with a significant illness cluster, such as the one we investigated, yet not be required to report to the MHO. In contrast, the Alberta Public Health Act (Section 26 Notification of epidemics and other threats) requires that any disease occurring in epidemic form or at an unusually high rate, or any illness suspected to pose a public health threat, be reported to an MHO.²¹ Furthermore, in Alberta, reporting requirements extend beyond health care workers to teachers and persons in charge of an institution.

This indoor ice arena incident highlights the benefit of front-line health care professionals collaborating with public health officials, and the importance of encouraging health care providers to report unusual events with possible public health implications. Efforts are underway to amend BC’s regulation using language similar to Alberta’s to require more inclusive reporting.

Summary

Several factors, including doors being closed due to cold weather, prolonged ice maintenance, and HVAC equipment failure, led to a buildup of toxic gases in an indoor ice arena. This caused 12 previously healthy adults to report respiratory symptoms. The treating physician contacted an Interior Health MHO about a possible respiratory illness cluster, which led to a prompt investigation, despite this reporting not being mandated by the current BC Public Health Act. The success of the investigation highlights the importance of including illness clusters in the reporting guidelines for health

Far worse consequences could have resulted if children rather than adult males had entered the ice surface immediately after this prolonged ice maintenance activity.

personnel. In addition, as public health organizations continue to promote healthy lifestyles, including regular exercise, the buildings in which these activities take place need to be monitored to ensure public safety. It is anticipated that Health Canada's research in this area will eventually inform the development of a document detailing national best practices, monitoring, and response guidance for facility/arena managers and public health professionals to reduce human health impacts. ■

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Competing interests

None declared.

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Taking steps to improve care and planning for patients in British Columbia with 22q11.2 deletion syndrome

No data, no problem, no action! Better institutional and provincial data sharing is needed to ensure evidence-based recommendations for the condition known as 22q11DS or DiGeorge syndrome can be developed, implemented, and updated.

ABSTRACT

Background: Patients diagnosed with 22q11.2 deletion syndrome, also known as 22q11DS or DiGeorge syndrome, have a diverse array of congenital anomalies and chronic health conditions. Because no study has reported on the coordination of multidisciplinary health services in British

Columbia required by individuals with 22q11DS, we set out to determine which health care services these patients access and what barriers in health informatics affect institutional and provincial data sharing.

Methods: A retrospective review of patient care at BC Children's Hospital (BCH) was conducted using the provincial discharge abstract database and databases from hospital specialty services involved in the care of patients with 22q11DS. Data were collected for patients seen at the hospital from April 2001 to March 2018. This 17-year review considered patient age at diagnosis, distribution of patient ages within the study cohort, number and type of specialty services accessed, and length of follow-up.

Results: A total of 293 patients with 22q11DS were identified from the hospital discharge abstract databases (DAD) and seven BCH specialty clinic databases. Data could not be retrieved from some clinic databases due to coding and reporting discrepancies, which prevented the amalgamation of data from all hospital specialty services. Data from the DAD and seven BC Children's Hospital specialty services were then amalgamated, and duplicates were removed to identify 293 unique patients with 22q11DS. On average, patients accessed five ser-

vices, with 13 new patients being seen each year and followed for an average of 7 years. Most of the pediatric care was provided by the Cleft Palate/Craniofacial Program, Cardiology, Endocrinology, and Otolaryngology. Using BC Women's Hospital Medical Genetics 22q11DS data (n = 400), we were able to corroborate the size of our study cohort and to estimate the prevalence of 22q11DS in BC for the study period.

Conclusions: Barriers to data retrieval and sharing at institutional and provincial levels were found to limit care coordination for patients with 22q11DS, who require ongoing, complex, multidisciplinary management. Incongruent and incomplete data systems in BC are hindering our ability to provide this coordinated care and plan transition, leaving us without the evidence needed by provincial health care providers, local experts, policymakers, and national and international 22q11DS research centres.

Background

In 1965 Dr Angelo DiGeorge first described the syndromic presentation of infants with thymic aplasia, hypoparathyroidism, and cardiac outflow tract anomalies.^{1,2} DiGeorge syndrome was later grouped with other phenotypically similar syndromes seen in clinical practice (e.g.,

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velocardiofacial syndrome, conotruncal anomaly face syndrome, Opitz G/BBB syndrome, and Cayler cardiofacial syndrome).^{1,2} With the advent of cytogenetic testing in the 1980s and fluorescent in situ hybridization (FISH) studies in the 1990s, a common underlying microdeletion was identified in all these syndromes: 22q11.2 deletion.

The condition now known as 22q11.2 deletion syndrome (22q11DS) is the most common microdeletion syndrome with a prevalence of roughly 1 in 3000 to 1 in 6000 live births.³ Affected individuals have a 50% chance of having an affected child; however, more than 90% of these deletions are de novo, with both parents being unaffected.^{3,4} Patients diagnosed with the syndrome have a diverse array of congenital anomalies and chronic health conditions.³ Specifically, 22q11DS is the second most common cause of patients presenting with both congenital heart disease (CHD) and global developmental delay (GDD).³ Clinical features are variable depending on age, with the most common presentations including two or more of the following: distinctive facial features [Figure 1]; conotruncal cardiac anomalies; palatal anomalies or functional defects with hypernasal speech and/or nasal regurgitation; immunodeficiency; hypocalcemia; cervical anomalies and/or



FIGURE 1. Pediatric male patient diagnosed with 22q11DS.

Reprinted with permission from Basset AS, McDonald-McGinn DM, Devriendt K, et al.⁴

scoliosis; GDD, learning, and behavioral challenges; and psychiatric illness.³ Many patients have neurodevelopmental disorders, including attention deficit hyperactivity disorder, learning disorders,⁴ and autism spectrum disorder (ASD).⁵ Although the majority of individuals

We recommend the addition of a genetic diagnosis (if known) to the discharge summary and abstract.

with this syndrome will not develop neuropsychiatric complications, a portion of young adults are at increased risk of concurrent neuropsychiatric disorders such as anxiety, depression, and schizophrenia.^{3,4,6} Anticipatory guidance and early developmental interventions to support learning, behavior, and mental health are essential.

While the phenotype, prevalence, and care requirements of patients with the syndrome are described in the literature, little information exists on coordinating health services and the care these patients require throughout life. The ability to study and characterize this population in British Columbia is limited by the diversity of specialty services accessed at tertiary health centres. These difficulties directly interfere with the implementation of best practice guidelines for the care of patients and their families.

BC Children's Hospital (BCCH) specializes in health care for the most complex children in the province, including those affected by 22q11DS, and thus can provide clinicians with insight into the provincial 22q11DS population.

We proposed a study of BCCH patients with two objectives: to investigate current health care utilization and coordination for 22q11DS patients in BC; to investigate current barriers in data sharing and health informatics for this population. We expected that individuals with 22q11DS would make frequent visits to specialty services and require specialized

multidisciplinary care for a number of years. We also expected to find significant challenges in institutional and provincial data sharing.

We hoped that by determining which health care services 22q11DS patients access and what barriers affect data sharing we might catalyze new collaborations involving pediatric subspecialties, community primary care providers, researchers, and policymakers and provide a foundation for improved care and planning for transition to adult health care.

Methods

We obtained ethics approval for this study from the University of British Columbia Children's and Women's Clinical Research Ethics Board (H18-00814).

Patients diagnosed with 22q11DS and treated at BCCH from April 2001 to March 2018 were considered eligible for inclusion in a retrospective review. The hospital discharge abstract database (DAD) was searched for patients treated at BCCH diagnosed with *ICD-10* code D82.1 (DiGeorge syndrome). A separate search of the outpatient clinic database sought additional patients associated with *ICD-10* code D82.1 or text describing a diagnosis of "DiGeorge syndrome" or "22Q deletion/transition."

To account for patients not found in the DAD because alternative identifiers were used, we contacted 12 clinics, programs, and services directly involved in the care of these patients: Cardiology, the Cleft-Palate/Craniofacial Program, Complex Care, Cytogenetics, Endocrinology, Immunology, Medical Genetics, Nephrology, Neurology, Orthopaedics, Otolaryngology, and Rheumatology.

We also queried Population Data BC (PopDataBC), the provincial resource for interdisciplinary health research, using *ICD-9* code 758.32 (velocardiofacial syndrome), *ICD-9* code 279.11 (DiGeorge syndrome), and *ICD-10* code D82.1 (DiGeorge syndrome).

Due to retrieval limitations, we could not obtain data from Immunology, Neurology, and Rheumatology at BCCH. We also could not make full use of data from the Cytogenetics service, from the Medical Genetics service based at BC Women's Hospital, or from PopDataBC.

A cohort of patients with 22q11DS was eventually identified by combining both the

DAD and databases for seven BCCH specialty services [Figure 2].

After identifying eligible patients, we performed an analysis of those from the DAD to take advantage of the breadth of data available, including clinic visit details and follow-up time. The Cytogenetics service at BCCH was able to provide additional data outlining specific methods used in the diagnosis of 80 anonymized patients diagnosed with 22q11DS. Due to health authority restrictions and the later inception date for the service (2007), cytogenetic data were not available for the entire study cohort.

To achieve our primary study objective, we quantified the number of patients found in institutional and provincial databases and took note of their demographic characteristics, including age and place of residence, and diagnostic details. Next we classified the admission rates of new and returning patients with 22q11DS over the 17-year study period. Finally,

we analyzed the distribution of patients across all health care services at BCCH.

To achieve our secondary objective, we considered limitations in data retrieval and amalgamation to identify current obstacles in data sharing and health informatics.

Results

Coding and reporting discrepancies prevented the collection and amalgamation of data from all relevant provincial and institutional clinics, programs, and services. These discrepancies primarily involved the Medical Genetics database, which could only be used to estimate the prevalence of 22q11DS diagnoses in BC for the study period (n = 400). The database

could not be amalgamated with the hospital discharge database because of incongruent ICD-10 coding, search criteria, and patients not diagnosed with 22q11DS or who did not meet study criteria (e.g., referrals for family and fetal losses). Amalgamation of Cytogenetics, Immunology, and Neurology data with the DAD was also not possible because of limitations in the clinical records and/or distribution processes used by these services. Pop-DataBC search results were inconclusive due to

ICD-9 coding deficiencies.

These limitations were addressed by analyzing subsets of data and amalgamating patient data from the discharge abstract database (n =

By increasing awareness of 22q11DS and supporting data sharing, we can improve care, implement transition planning, and translate knowledge into practice.

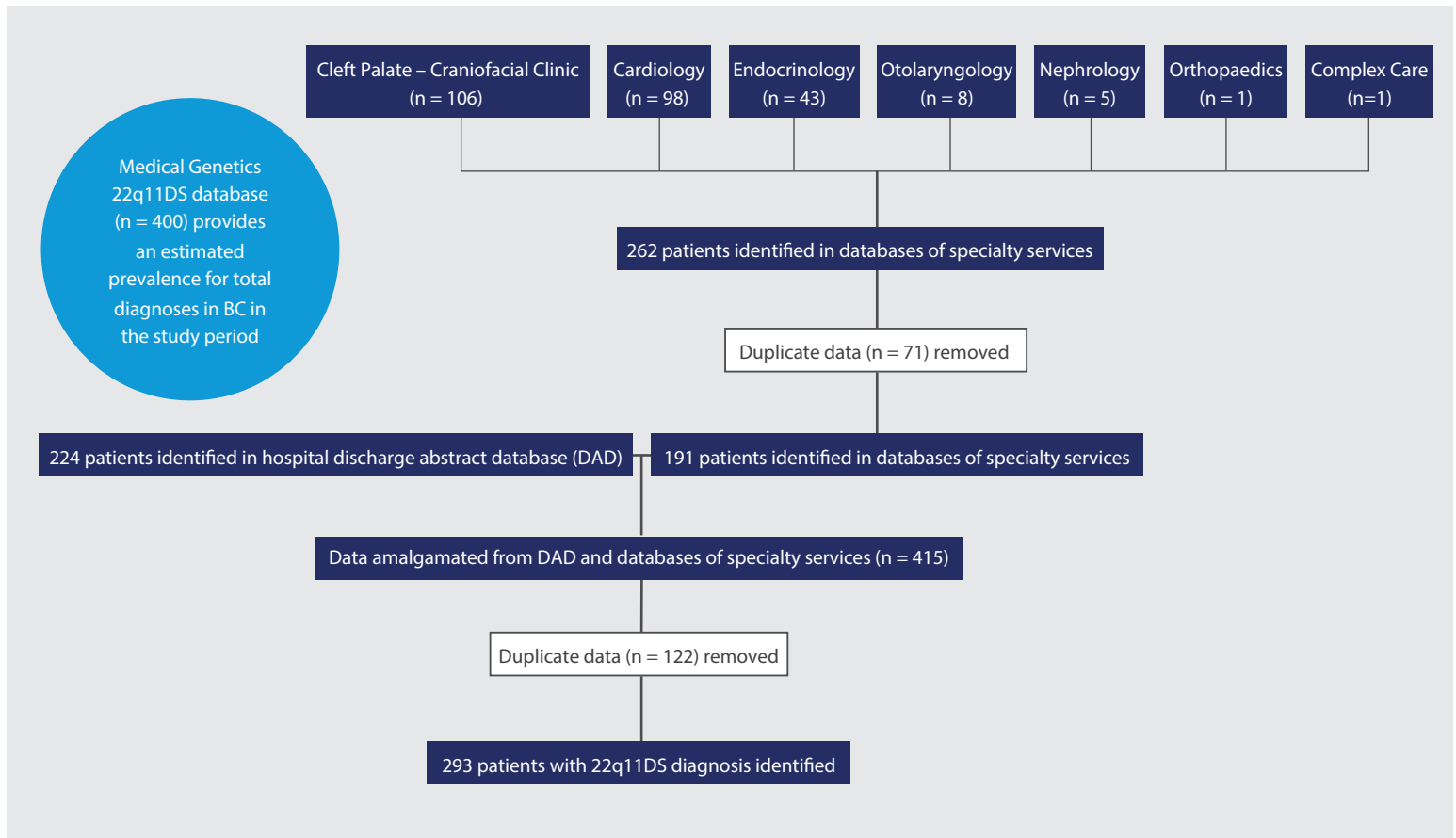


FIGURE 2. Data retrieval process used to address database discrepancies and duplication and identify patients with 22q11DS treated at BC Children’s Hospital (BCCH) from April 2001 to March 2018. Discrepancies within Medical Genetics database prevented data amalgamation within our study; however, their data (n = 400) provided an estimated prevalence for total diagnoses in BC in the study period, including referrals for proband, family, and fetal losses.

224) and other BCCH sources (n = 191) and removing any duplicates (n = 122) to identify a total of 293 unique patients.

Demographic characteristics

Of the 293 patients studied, 57% were female (n = 166) and 43% were male (n = 127). The median age at genetics diagnosis was 3 years (IQR = prenatal to age 21 years).

Age distribution was calculated based on patient date of birth. Looking at the records for all patients in the study cohort, 33% were within the transition age range (12 to 19 years) as defined by the British Columbia ONTRAC adult transition program.⁷ Additionally, 23% of patients were older than 19 years and 44% were younger than 12 years.

Upon further analysis of age distribution, patients not captured in the DAD and seen by specialty services (n = 69) had a median year of birth of 1996 (IQR 1992 to 2006), whereas patients within the DAD (n = 224) had a median year of birth of 2004 (IQR 1999 to 2009).

Regarding place of residence in British Columbia, most patients resided in the Fraser Health Authority (45%) or the Vancouver Coastal Health Authority (18%), and no obvious differences were found when comparing specialty services patients and DAD patients.

Diagnostic information

Diagnostic information was analyzed using data for 80 patients provided by the Cytogenetics service at BCCH. The Cytogenetics database was established in 2007 and captures a portion of genetic diagnoses in the province. All of the data provided were anonymized, thus preventing amalgamation with other data. We used this subgroup of patients primarily as a proxy to gain an initial understanding of the genetic diagnosis of 22q11DS in BC. We found increasing genetic diagnoses of this condition at BCCH with the advent of the Cytogenetics database. Specifically, cytogenetic testing confirmed 3 diagnoses in 2007 compared with 12 in 2017. From the 80 patients with available genetic data, 46% were diagnosed at or before 1 year of age, 10% were diagnosed in adolescence, and 13% were diagnosed in adulthood [Table 1]. Of the prenatal cytogenetic diagnoses, 86% were made with peripheral blood samples and 14% with

prenatal diagnostic studies (i.e., amniotic fluid, tissue of conception, or fetal blood).

Since the introduction of cytogenetic testing in the early 2000s, there has been a shift to chromosomal microarray analysis (CMA). With the implementation of CMA in 2009 and the Treatable Intellectual Disability Endeavor (TIDE) protocol in 2011, the scope of CMA requisitions in BC has expanded and we have seen more 22q11DS diagnoses made with this technology. Nearly all genetic diagnoses from 2013 onward have been with CMA.

Admission rates and follow-up

On average, 13 new patients were admitted or seen as outpatients at BCCH each year of the study and followed for 7 years. The PopDataBC platform was not able to yield a cumulative denominator for total provincial 22q11DS diagnoses per year because ICD-9 coding was used primarily for billing purposes rather than to identify underlying diagnoses. Nevertheless, our proxy of 13 new patients annually reflects the reported birth prevalence of the syndrome (1:3000 to 1:6000)³ and average annual births in BC since 2001 (n = 43 400).⁸

TABLE 1. Age at genetic diagnosis of 22q11DS by fluorescent in situ hybridization (FISH) or chromosomal microarray analysis (CMA) for 80 patients in Cytogenetics database of BC Children’s Hospital, 2007 to 2018.

Age category	Number of diagnoses in category
Prenatal	10
0–1 year	27
2–5 years	10
6–10 years	5
11–19 years	7
20–30 years	11
31+ years	10
All diagnoses	80

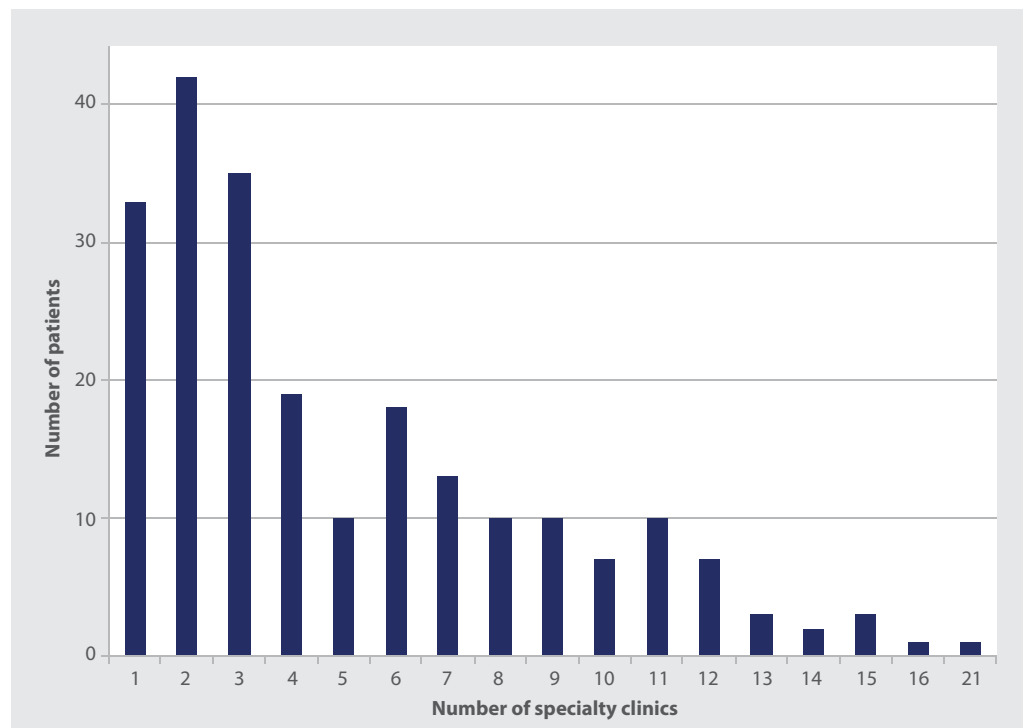


FIGURE 3. Number of specialty services accessed by 224 patients with 22q11DS identified in the provincial discharge abstract database, 2001 to 2018.

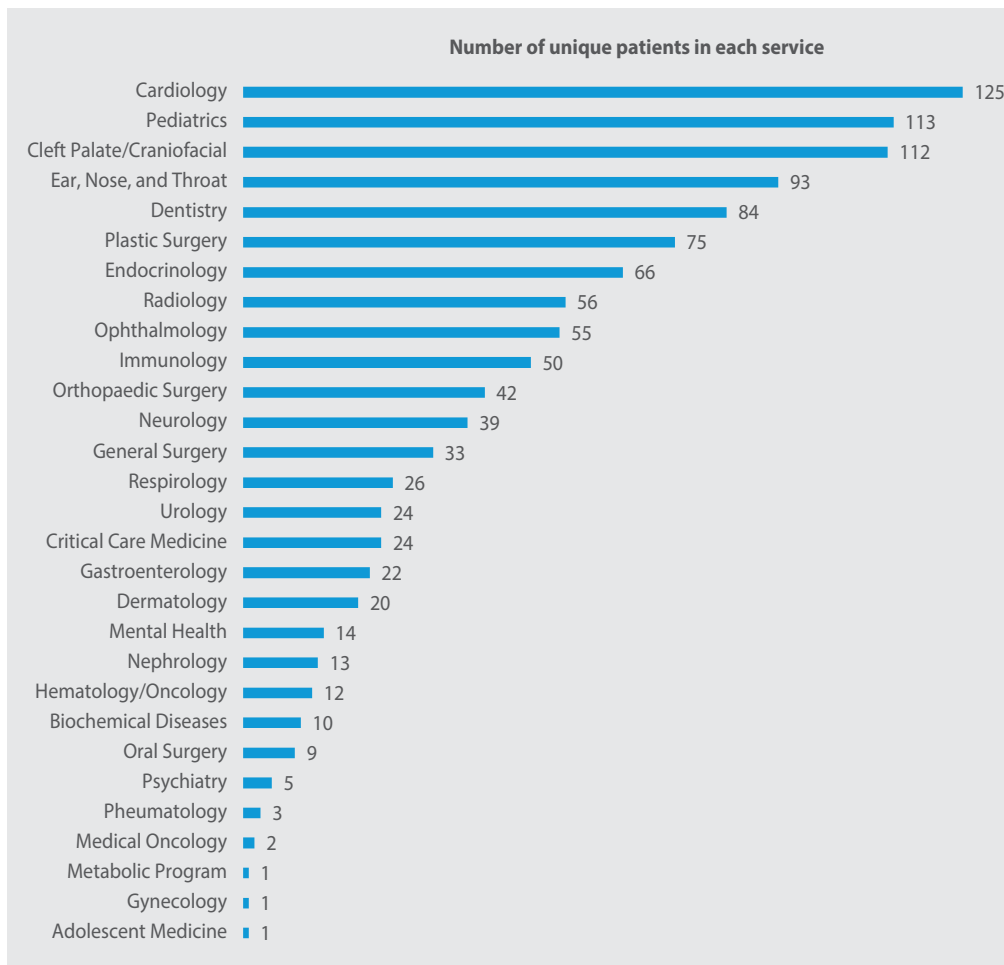


FIGURE 4. Distribution by specialty service of unique patients seen with 22q11DS identified in the provincial discharge abstract database, 2001 to 2018.

TABLE 2. Selected specialty services accessed by 224 patients with 22q11DS identified in the provincial discharge abstract database, 2001 to 2018.

Specialty service	Median age in years at visit (IQR*)	Number of unique patients	Total visits
Cardiology	1 (0–7)	125	1234
Pediatrics	2 (0–5)	113	937
Endocrinology	7 (4–12)	66	582
Otolaryngology	5 (3–8)	93	536
Dentistry	7 (4–10)	84	509
Cleft Palate/Craniofacial	6 (4–7)	112	357
Orthopaedic Surgery	9 (5–13)	42	326
Ophthalmology	3 (1–7)	55	310
Plastic Surgery	5 (3–8)	75	189
Radiology	3 (1–9)	56	84
Immunology	1 (0–4)	50	70

* IQR = interquartile range

Specialty services used

Each 22q11DS patient identified in the DAD (n = 224) was seen by an average of five clinics, programs, or services [Figure 3]. More than 50% of these patients visited more than three specialty services at BCCH.

The specialty services accessed by patients were analyzed to determine which had the largest cohort of unique patients [Figure 4]. The majority of patients in the DAD received care from Cardiology (Cardiac Surgery and Cardiology) (n = 125), Pediatrics (General Pediatrics, Developmental Pediatrics, and Social Pediatrics) (n = 113), the CP/CFP (Specialty Pediatrics, Plastic Surgery, ENT, Orthodontist/Dentistry, Audiology, Speech Language Pathology, Nursing, and Social Work) (n = 112), and Otolaryngology (Ear, Nose, and Throat Clinic, and Surgery) (n = 93). Each of the specialty services provides access to a number of different subspecialists and allied health professionals, which means many patients saw more than five specialists during their care. The most common service combination was Cardiology, CP/CFP, and Developmental Pediatrics, with 73% of patients seen by one or more of these specialty services and 36% seen by two or more. When looking at unique-patient visit volume, Endocrinology had 10% of the total visits for all 22q11DS patients at BCCH during the study, even though the service cared for only 6% of these patients [Table 2]. Finally, while the majority of patients seen by Cardiology and Pediatrics were age 2 or younger, as these patients aged their care shifted to other specialties, namely Otolaryngology, CP/CFP, and Dentistry.

Data sharing

A number of barriers hindered acquiring data for this patient population. First, the current ICD-10 coding platform is sensitive but not always specific for the presence of a genetic 22q11.2 deletion. This contributes to variability across databases in the coding of this syndrome, especially in cases where patients present phenotypically without a genotypic deletion. In BC the only way to ensure a genetic diagnosis is to cross-match the patient with local cytogenetic databases. These databases are at three locations across the province, with the BCCH Cytogenetics service accounting for only a portion of provincial diagnoses. As well

as having different inception dates, none of the cytogenetic testing services were established for data sharing or research.

Second, disparities in data sets across specialty services and administrative networks prohibit amalgamation with Cytogenetics or Medical Genetics data and leave some patient information in isolated databases. BC Children's Hospital and BC Women's Hospital both provide services for children with 22q11DS and their families. Family-centred care is facilitated by the placement of Medical Genetics at BC Women's Hospital, but can pose a logistic barrier for the study of pediatric patients with a variety of genetic conditions. The current extensive Medical Genetics database is sensitive for 22q11DS, but can lack specificity. While referral data for probands, family members, and fetal loss are captured, not all these data describe patients with an underlying deletion, and our study did not have the resources to overcome this challenge.

Third and finally, the PopDataBC platform does not provide a reliable denominator for our provincial 22q11DS population, which can be attributed primarily to physicians coding for the presenting condition (e.g., cleft palate), rather than the underlying genetic syndrome. Furthermore, although the majority of patients are seen at BCCCH for complex CHD and palatal defects, a discreet subset of patients is served at regional centres (e.g., Victoria, Kelowna, Prince George, and Surrey) and their data are not captured.

Conclusions

This study highlights the complexity of health care for patients with 22q11.2 deletion syndrome and identifies the data sharing and transition planning challenges we need to address (see Key practice points). On average, pediatric-aged 22q11DS patients are seen by specialists and subspecialists at five tertiary care programs and are followed for 7 years.

Since 2009, chromosomal microarray analysis has been the diagnostic tool of choice for suspected 22q11DS and the gold standard for investigating intellectual disability (ID), ASD, and multiple congenital anomalies.⁹ The increased use of CMA has allowed physicians to circumvent difficulties associated with the

phenotypic heterogeneity in clinical presentation and permitted early detection and management of a complex medical condition.

Through improved data sharing systems for 22q11DS and other rare disorders, we will have the opportunities to enhance the patient and family experience, increase system efficiency, and improve health outcomes.¹⁰

Study challenges

We found that diagnostic coding varied across databases and administrative networks and that patients with 22q11DS were frequently entered into the discharge abstract database under their presenting diagnoses (e.g., cleft palate, CHD, ASD, ID) and were therefore missed in our search. We also found that some specialty services patients were originally referred by smaller outreach subspecialty consultation clinics or were entered into local health authority or private databases with different patient diagnostic coding and, therefore, not captured by the provincial DAD. This small but distinct cohort of patients with minimal hospitalizations and/or outpatient consultations at BCCCH was missed when we used hospital discharge summaries to identify patients. The 8-year median age difference between patients captured only in specialty service databases compared to the DAD patients reflects the delayed or attenuated interaction with our tertiary pediatric care centre over the study period.

In a North American context, our results demonstrate an annual increase in the cumulative 22q11DS patient cohort over 17 years, a trend consistent with findings from a study at Seattle Children's Hospital.¹¹ This trend is predominantly attributed to improved diagnostic technology (i.e., CMA), greater awareness of the syndrome, and an increase in referrals to tertiary care centres.¹¹ Additionally, improved pediatric surgical survival rates and the success of modern pediatrics have produced a growing population of young adults with multimorbidity complex care needs.

Study limitations

The retrospective design of the study and the different inception dates of the databases we used impaired our ability to identify a cohort strictly adhering to the 17-year review period.

As well, our study analyzed health care utilization as a proxy for care needs and did not include a formal qualitative component, thus limiting our holistic understanding of patients care needs.

Recommendations

Despite the extensive scientific understanding of 22q11DS, we do not have integrated case management and data sharing across subspecialties, which makes it difficult for primary care providers, community pediatricians, subspecialists, researchers, and health care planners to ensure evidence-based recommendations are being developed, implemented, and updated.

The results of our study highlight this problem and provide insight into the provincial population of 22q11DS patients. These results may also provide other Canadian jurisdictions with a population health perspective, given that the study took place at BC's only pediatric tertiary care centre. Furthermore, the results emphasize the multidisciplinary complex care needs of these patients and demonstrate the difficulties associated with data amalgamation at institutional and provincial levels.

To address these concerns, we recommend the following:

- Development of a Canadian (or international) 22q11DS patient data registry. A registry would enable prospective input of patient data with filtration criteria and subcategories to document and study the syndrome (e.g., deletion subtype, phenotypic presentation, surgical/medical procedures, transition visit recommendations) and ensure consistent documentation and coding of genetic diagnoses.
- Addition of a genetic diagnosis (if known) to the discharge summary and abstract. Inclusion of genetic diagnoses in the records for all patient encounters (inpatient admissions and outpatient visits) and the use of more specific ICD codes would support advances in tracking, understanding, and caring for patients locally, nationally, and internationally. Implementation of the *ICD-11* beta platform, including coding for deletions on chromosome 22 as distinct identifiers, can be expected to reduce current coding ambiguities.

- Introduction of a formal transition process for patients with 22q11DS moving from pediatric to adult care in BC. Consistent evaluation, knowledge translation, and quality improvement initiatives for health professionals would help patients as they move from pediatric to adult care, as already outlined in the 2011 pediatric care⁴ and 2015 transition to adult care consensus guidelines.⁶
- Establishment of a provincial 22q11DS centre of excellence. A centre of excellence in BC would improve the care of adult 22q11DS patients, which has not yet advanced to international standards.¹² Such a centre could also address the complex care needs these patients and their families face from early childhood through to

adolescence and adulthood by promoting better functional outcomes in health, mental health, independence, participation, and employment.

By increasing awareness of 22q11DS and supporting data sharing through collaboration between provincial health care providers, local experts, political figures and policymakers, and national/international 22q11DS Centres of Excellence, we can improve care, implement transition planning, and translate knowledge into practice. ■

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Competing interests

None declared.

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Key practice points: Managing patients with 22q11DS

- The care of patients with 22q11.2 deletion syndrome, also known as 22q11DS or DiGeorge syndrome, can involve many health care providers, including allied health professionals, family physicians, community pediatricians, and other specialists and subspecialists.
- Patients with 22q11DS can present with significant clinical variability, leading to a wide range of ages at the time of diagnosis.
- Most 22q11DS patients will present at routine primary care visits with feeding problems, developmental delay, or early mental health concerns (e.g., speech, attention, or learning difficulties; anxiety, autism spectrum disorder).
- 22q11DS is actually a common "rare disorder," with an annual birth prevalence of 1:3000 to 1:6000.
- A significant proportion of family physicians will have patients with 22q11DS in their practices and will benefit from up-to-date best practice guidelines and data sharing.
- Chromosomal microarray analysis (CMA) is the current gold standard for an initial diagnosis of 22q11DS.
- A significant number of hospital specialty clinics, programs, and services provide care for 22q11DS patients, with most pediatric care delivered by cardiology, developmental pediatrics, cleft palate programs, endocrinology, and otolaryngology services.
- Education, information-sharing, and resource networks are fundamental for patients with 22q11DS, who often require several years of active multidisciplinary follow-up involving more than 10 health care providers, making planning the transition journey daunting for the majority of these patients and their families.
- We have the opportunity to model a best-practice "ON-TRAC"⁷ transition care pathway for other rare disorders by developing an effective "triple aim (to improve health, care, and cost)"¹⁰ transition program for 22q11DS, with improved data linking, family-centred approaches, and provincial collaboration.

The Patient Experience Tool: Incorporating the patient's voice into quality improvement activities

The GPSC's Practice Support Program (PSP) supports family physicians to transform primary care and ensure that all patients in BC have access to quality primary health care that meets their needs. Supporting physician practices to undertake quality improvement work is an important component of the program's goal of improving care. This includes ensuring that patients are able to share their experiences of care, and that their voices inform health care change.

To gather patients' perspectives on the care they receive, PSP partnered with physicians to create the GPSC Patient Experience Tool. The tool gathers information using a survey of 14 to 20 questions covering topics like wait times, office hours, and coordination of care. Six mandatory provincial questions are included, after which practices can customize the survey by adding questions from a bank of prewritten options (with the ability to change out questions once an improvement has been achieved).

The survey interface enables patients to efficiently and anonymously share information about their experiences and interactions with the practice. Responses are accessible to practice team members via an easy-to-use, web-based dashboard—survey data are anonymized and aggregated in real time on a secure platform (to ensure anonymity, a minimum of five responses to a question are required before results are accessible).

The tablets on which patients complete the survey are issued by PSP and are rotated between participating clinics every 6 to 8 months;

however, hardware can be made available for longer periods to practices that choose to survey their patients for ongoing quality improvement activities.

PSP regional support team members are available to coach practices on how to set up the tablet and survey, and can support practices to:

- Determine readiness and get started.
- Select meaningful and relevant survey questions.
- Incorporate the survey into clinic workflow, including determining team member roles and responsibilities.
- Review results and use data to identify, plan, implement, and measure quality improvement activities.
- Help navigate compensation and certification requirements/benefits.

Data gathered through the Patient Experience Tool can be used to:

- Inform quality improvement activities.
- Encourage longitudinal care.
- Support interprofessional teams.
- Contribute to a family practice's adoption of the attributes of a patient medical home.
- Bolster a practice's readiness to participate in a primary care network.

Initially piloted by 39 clinics, the Patient Experience Tool survey has been completed by more than 6000 patients since 2016. One practice in Langley that implemented the tool heard from 140 patients who provided their perspectives on the practice's office environment, their relationship with the doctor, their interactions with the health care team, and their

confidence in their self-management skills. Results from the patients indicated that there was room for improvement in wait times and clinic access. The practice team, supported by the regional support team, used this feedback to

initiate a number of quality improvement activities, including completing appointment forms in advance and helping patients plan for effective appointments by telling them what to expect. By implementing these strategies, the practice

team was able to cut patients' average wait time from arrival to being seen by two-thirds—from 60 minutes to 20 minutes.

In addition to using data for quality improvement activities, family physicians can opt to share aggregated data with their local division to help support community planning, identify local population needs, understand the impact of local initiatives, and see how their results compare to those of their division peers.

Compensation and certification

PSP offers compensation and certification for time spent on this (and other) practice improvement work:

- Compensation: Doctors and eligible team members can receive PSP compensation for up to 15 hours.
- Certification: Doctors can receive up to 45 certified Mainpro+ credits (three credits per hour, for up to 15 hours).

Visit www.gpsc.bc.ca to learn more. ■

—Alana Godin
Director, Community Practice and Quality,
Engagement and Quality Improvement

This article is the opinion of the GPSC and has not been peer reviewed by the BCMJ Editorial Board.

Canadian Blood Services: More than just blood

Five things to know about Canadian Blood Services that may be relevant to your patients.

E.M. Wong, MD

Canadian Blood Services is a critical part of Canada's health care system. As physicians, we often use blood products for our patients but rarely reflect on the breadth of activities that Canadian Blood Services oversees and the selfless volunteer donations made by Canadians.

20 years and counting

Canadian Blood Services recently celebrated 20 years in operation. The organization was formed on 28 September 1998 as an arm's-length organization to manage Canada's blood supply in response to the Krever inquiry into the blood system after thousands of people received infected blood products in the 1980s.^{1,2} During the past 20 years, the role of Canadian Blood Services has expanded from blood and blood

products to include both adult and cord blood stem cells, plasma sufficiency, and organ/tissue donation and transplantation.^{1,3} Canadian Blood Services highlighted 20 years of growth and maturity with a new logo and tagline (Canada's Lifeline) to better reflect this broader mandate as it continues to help patients in need.

Blood donations

Although more than half of Canadians are eligible to donate blood, only 1 in 25 does.^{4,5} Last year more than 410 000 donors visited clinics across the country, including British Columbia's five permanent collection sites and the numerous mobile clinics operated around the province. The minimum age to donate blood at Canadian Blood Services is 17,⁶ but there is no maximum age.^{6,7} Canada's oldest donor, a 95-year-old woman from Port Coquitlam, was celebrated last year.⁸

Iron deficiency is not uncommon among frequent blood donors, and Canadian Blood Services implemented changes in 2016 to reduce this risk. The interdonation interval for female whole blood donors was increased to 84 days from 56 days, and the minimum hemoglobin requirement for male whole blood donors was increased to 130 g/L from 125 g/L. Plans include selective ferritin testing for frequent donors who are at highest risk of developing iron deficiency.⁹

Stem cell donations and transplantation

Canadian Blood Services operates a stem cell program that provides hematopoietic stem cells for transplantation. Last year alone, Canadian Blood Services facilitated more than 400

unrelated transplants for Canadian patients through its adult stem cell registry and its cord blood bank.¹⁰

Did you know that for Canadian patients in need of a hematopoietic stem cell transplant the chance of finding an unrelated stem cell donor match is 80% to 90% for Caucasians, but falls to lower than 15% in non-Caucasians?¹¹ This reflects the lack of ethnic diversity in the stem cell registry [Figure 1], not only in Canada but worldwide. Unlike blood donation, allogeneic stem cell transplantation requires more stringent cell matching due to human leukocyte antigen (HLA) typing, which is determined by racial background and ethnicity. Efforts are being made to increase the biological diversity of the Canadian Blood Services stem cell registry by registering more potential adult donors to better reflect the current makeup of Canada's population.

Potential donors (healthy people between 17 and 35 years of age) can register online by completing a health questionnaire and be HLA-typed after providing a buccal swab to join the 400 000 Canadians already on the registry.¹²

The Canadian Blood Services cord blood bank was established in 2015, and one of its collection centres is at BC Women's Hospital in Vancouver. The other three collection centres are in Edmonton, Ottawa, and Brampton. Rather than being discarded as medical waste after the natural process of delivery, cord blood stem cells can be banked for an extended period. Cord blood stem cells are lifesaving for patients in need of stem cell transplant and, because of the less rigorous requirement for HLA matching due to the immaturity of the fetal blood stem cells, they provide some advantages over adult stem cell transplantations.¹³ The ethnic diversity of the cord blood bank is broader than that of the adult registry with more mixed-race units [Figure 2]. Currently there are more than 3000 cord blood units listed in the Canadian Blood Services bank and available for transplant, and 21 have been distributed and transplanted to date. Informed consent for cord blood donation must be obtained before the donor is in active labor, ideally as part of her prenatal care with her primary caregiver.¹⁴

Dr Wong is a family physician with a focus in elder care. As a Canadian Blood Services volunteer for the past 10 years, she organizes public awareness campaigns on how to "give life" by donating blood or cord blood, or by registering as a potential adult stem cell or organ/tissue donor. Her childhood experience of being a blood recipient and her husband's experience of not being able to find a suitable stem cell donor for his aplastic anemia, as well as learning about others' struggles, inspired her to give back. She is truly humbled by and grateful for the many volunteers who selflessly donate to Canadian Blood Services.

This article has been peer reviewed.

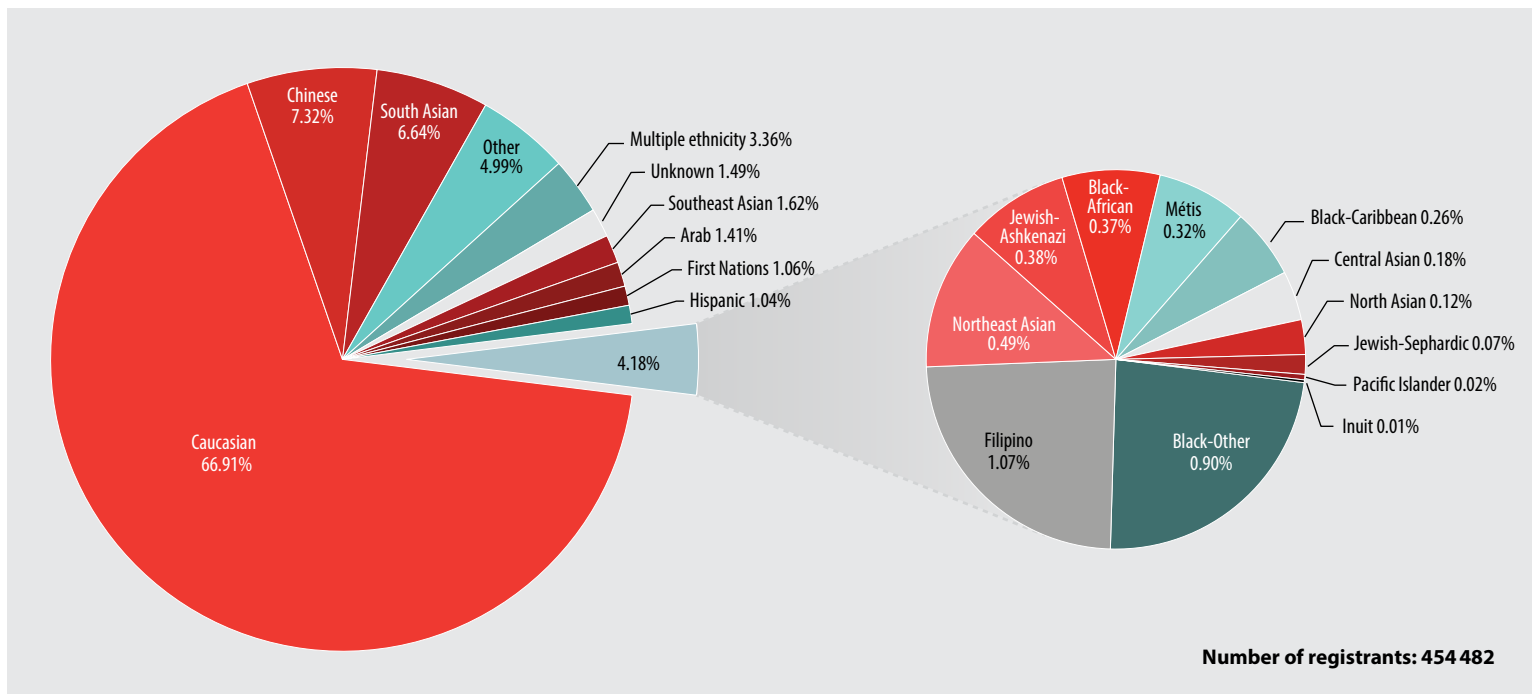


FIGURE 1. Ethnic composition of adult stem cell registry (provided by Canadian Blood Services, September 2019).

Organs and tissues: Donations and transplantation

Canadian Blood Services helps coordinate organ and tissue donation and transplantation in partnership with provincial organ donation organizations like BC Transplant. The Kidney Paired Donation (KPD) program, launched in 2009, is an example of interprovincial health systems working together to forge success beyond provincial borders and improve access to transplants for patients. The success of this program can be attributed to the selflessness of those who have stepped forward to be living organ donors. KPD is operated as part of the Canadian Transplant Registry, a national web-based computer program operated by Canadian Blood Services and used to link the national potential recipient wait list with actual organ donors.

Working with partners across the organ and tissue donation and transplantation community, Canadian Blood Services also develops leading practices, supports professional education and public awareness activities, and collaborates on new ways to share data on the performance of the donation and transplantation system in Canada.¹

Continued on page 64

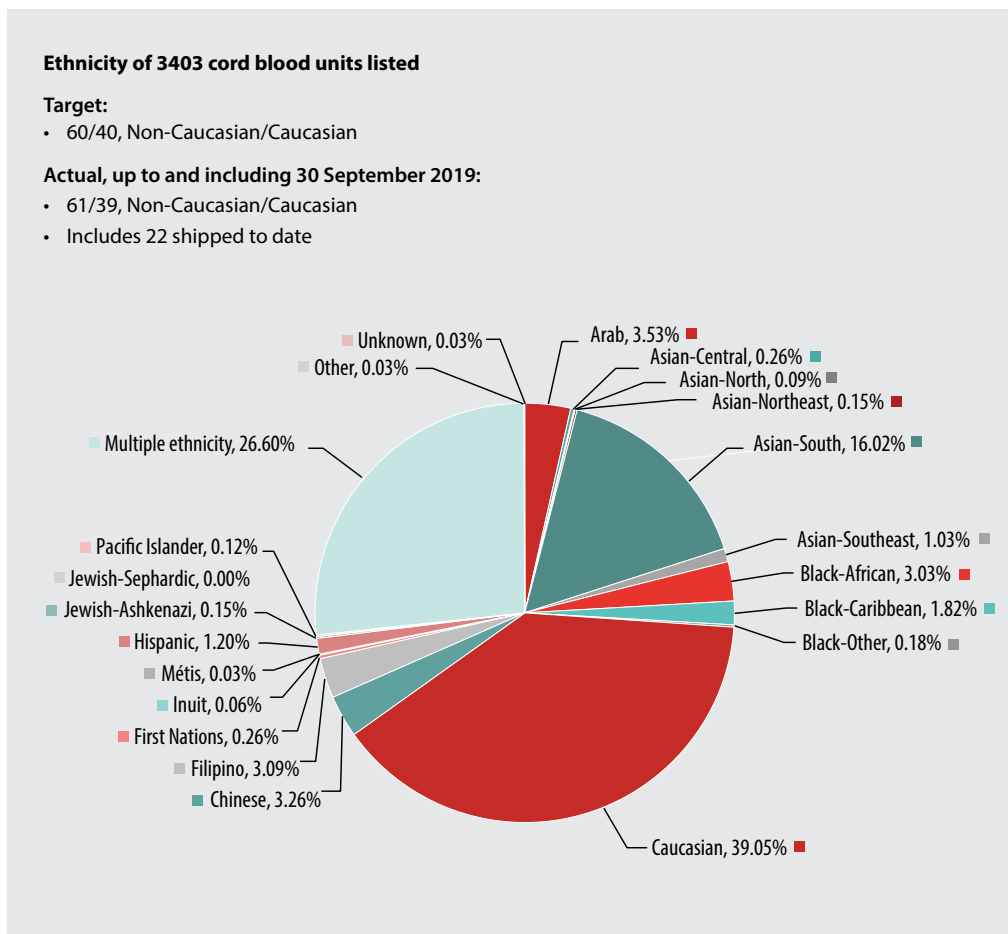


FIGURE 2. Ethnic composition of cord blood bank (provided by Canadian Blood Services, September 2019).

Plasma

Canadian Blood Services operates a national formulary for plasma protein products, including immune globulins, clotting factor concentrates, and albumin to name a few. Canadian Blood Services is embarking on a project to significantly increase the amount of plasma that can be collected from unpaid donors. This plasma can be directed to the production of plasma protein products such as immune globulins to improve plasma sufficiency in Canada. In August 2019, Canadian Blood Services announced plans to open a proof-of-concept source plasma collection site in Kelowna.¹⁵

Conclusion

Canadian Blood Services plays a vital role in the health care system, and physicians should be aware of its origins and its expanded scope encompassing blood and blood products, stem cells (adult and cord blood), organs, and tissue. Because the criteria for blood donation, such as ferritin levels, deferral periods, and eligibility, can change, the most up-to-date information should be obtained from www.blood.ca. Iron levels should be monitored in regular whole blood donors. As stem cell transplants are dependent on HLA matching, increasing the ethnic diversity of the stem cell registry is paramount. In this regard, primary care physicians should encourage public cord blood donation as part of prenatal care, especially in underrepresented groups.

Iron levels should be monitored in regular whole blood donors.

Since volunteer donations are critical to its continued operations, physicians should also consider their role in educating the public about Canadian Blood Services. Not only do existing patients need its services daily, some day physicians and their families and friends could be those patients as well. ■

Competing interests

None declared.

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Exercising in pollution: How to counsel patients

Chronic exposure to air pollution is undoubtedly harmful; we are familiar with its associations with brain cancer, asthma, and cardiovascular disease. We are also well versed in the health benefits of exercise, from reducing stroke risk to chronic pain and mood disorder management. How then do we weigh the risk of exercising in pollution against the detrimental health effects of a sedentary lifestyle? It's important for physicians to advise healthy patients whether, how, where, and when to exercise in air pollution.

Dr Michael Koehle is a UBC professor and exercise medicine specialist who researches exposure to pollution during exercise in healthy individuals and measures surrogate outcomes such as lung and endothelial function to predict health risk. He and his colleagues have examined cyclists breathing in diesel generator exhaust in a laboratory setting, measuring lung function and exercise performance. Under these conditions, lung function did not improve as it typically does during exercise, but was not worsened. Blood vessel function and performance outcomes were similar.¹

Dr Koehle has also examined the physiological effects with varying intensity of exercise in air pollution. Contrary to what was expected, performance and lung function don't significantly worsen with increased intensity and ventilation. With this in mind, physicians could consider counseling patients to limit outdoor workout duration and instead opt for shorter, higher intensity workouts.

This article is the opinion of the Athletics and Recreation Committee, a subcommittee of Doctors of BC's Council on Health Promotion, and is not necessarily the opinion of Doctors of BC. This article has not been peer reviewed by the BCMJ Editorial Board.

Although diesel is a major offender, road pollution is in fact a complex mixture of pollutants including ozone, nitrogen monoxide and dioxide, ultrafine particles, black carbon, and carbon monoxide. Even so, Dr Koehle's findings are similar to other studies globally. A real-world pollution study from Barcelona² and an epidemiological study in Copenhagen³ have also found that health outcomes are not worsened by air pollution. That said, we still know that air pollution is harmful, and reducing overall exposure is important.

Air quality varies significantly in urban areas from one area of the city to the next, depending on traffic density, truck corridors, wind, and other factors. A 2019 report measuring air quality over 2 years in Vancouver and Toronto reveals that Vancouver has unsafe levels of pollution in proximity to major roadways, especially highways and truck routes (diesel trucks contribute disproportionately to pollution).⁴ Emissions concentrations in high wind can be 4 times lower or 6 times greater just downwind from a major road. Pollution also worsens during weekdays, rush hour, and in wintertime.

Emphasize to your patients the importance of separating from pollution in space and time. Consider alternative commuting paths and avoid proximity to highways and large-truck corridors. Plan sporting activities in quieter residential neighborhoods. Limit exposure during high pollution times like rush hour and on weekdays, in colder temperatures, in low wind or downwind, or when the air quality index is high. Check Environment Canada's website or use an app such as Plume Air Report for current air quality data and forecasting.

Finally, consider your patients with respiratory disease and asthma. Ensure they take their

bronchodilator, have their medication on hand, and do proper warmups. Bronchodilators have shown to be beneficial for asthmatics in poor air quality, despite opening up the airways to more emissions.⁵

Our health is being impacted by climate change and pollution, and air quality may become a more serious concern in the future. Physical activity is important, however, and it is still reasonable to advise

healthy patients to continue exercising, and to do so in the safest way possible. ■

—JoyAnne Krupa, MD

Emphasize to your patients the importance of separating from pollution in space and time.

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Consciousness

One anesthesiologist's take on it.

Mark Elliott, MD, FRCPC

Anesthesiologists take consciousness away from a patient before a surgical procedure and then bring consciousness back to the patient after the operation is finished. Consciousness has been an important topic in religion and philosophy for millennia, but with neuroscience progressing the way it is, it is becoming an important topic in science as well. The main problem is that consciousness is qualitative but science is quantitative. It was Galileo who first made science totally quantitative when he started rolling balls down an inclined plane and found that the distance rolled was related to the square of the time taken. Science has been on a roll ever since.

I am going to take the point of view that, in principle, neuroscience should eventually be able to figure out quantitatively what qualitative consciousness is. The progress in neuroscience on this subject has been startling over the past few decades; however, as the metaphor states, we are at the stage of listening for a heartbeat with a stethoscope on an acorn.

On the opposite side of this empiric bias is the point of view that consciousness will never be explained unless there is some supernatural force present to explain the mystery. This implies that the fundamental building blocks of reality are conscious, which usually leads to all sorts of ethereal terms like panpsychism (everything is conscious). There is some scientific truth to this. Richard Feynman used to wonder if an electron had its own mind. There is a mathematical proof of something very similar by Conway and Kochen, who basically say that if we (humans) have free will to choose to measure

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This article has been peer reviewed.



something, which basically means our decisions are not based completely on the past (a real deterministic universe) then the particles must also have free will.

What

We can talk about *level* of consciousness and *content* of consciousness—the functional aspects of consciousness that most would say arise in patients' brains—but then there is the “hard” problem of consciousness.

Anesthesiologists are experts on the level of consciousness. Basically we know what depth of anesthesia (level of consciousness) we need to take patients to without killing them. Anesthesiologists don't know much about the content of consciousness. We don't know what a patient's inner voice is saying. We can guess, but we can never know for certain. Humans pick up this trait of being able to guess what another person is thinking at about 5 months of age, according to child psychology. But what about dreams? In a certain sense a patient is conscious when dreaming.

The hard problem is understanding what it feels like to be conscious. The defining essay,

written in 1972, was entitled, “What is it like to be a bat?”¹ Many argue that no matter how much we discover in neuroscience we will never understand a bat's inner feelings. There is a bit of a linguistic debate here, and some say *experience* is a better word than *understand*.

Discussion such as this usually leads to the mind/body/brain problem. Again this is an old problem dating back at least to Plato with billions if not trillions of words written about it. But in essence there are only three ways to think about it. One, your mind and body/brain are the same thing; when you die, your mind and body/brains dies. This is what the ancient Greeks thought. The second is the scientific way, first outlined by René Descartes, that your mind, which he called *res cogitans*, or thinking stuff, acts like an operating system on your desktop controlling the body/brain stuff, which he called *res extensa*, from the pineal gland, which was the only unpaired homunculus in the brain. The theory did not pan out. The third is the religious way of thinking about it, which started long before the other two ways, and says floating somewhere above your body/brain is your mind or soul and, that the soul never really dies.

To sum up, consciousness is either the most mysterious thing in the universe or the most not-mysterious.

When

I ask the reader to consider the following children's story about evolution. Billions of years ago, a small single-cell organism (let's call him Mark) is floating in a black unoxidized sea veneered on Earth's surface, randomly bumping into smaller things it can ingest to basically stay alive and reproduce. Bigger things eat Mark. I doubt Mark is conscious.

Over a few million generations Mark develops the ability to move by a small flagellum or some other type of propeller in water. Now he can move toward food and away from danger. I doubt Mark is conscious.

Millions more generations later Mark is a small worm with the ability to eat and then hide somewhere safe to digest. Conscious? I don't know.

A few million more generations go by and Mark has eyes and sticks his head out of the sea. In the black ocean he can see (*sense* is a better word) not even a millimetre in front of him and has to immediately react to the environment (a predator) or else be eaten. In the atmosphere there is now much less photon attenuation and Mark can see for perhaps a kilometre. There is now a time delay between the seeing and the need to act (to get something to eat). Mark is now aware of this. And conscious?

Millions more generations of evolution go by and now Mark has a brain big enough to give him an internal representation of what he sees so he can plan what to do in order to eat. He now has what the psychologists call object permanence (he knows something is there even when he closes his eye). Mark is probably conscious.

Because this development has been so successful at eating, there are now millions of Marks. They have a sound-based language and are able to cooperate, construct hypotheses, test things with experiments, and make the world a better place for all the Marks. All this neocortical functionality was driven by the need to cooperate with the other Marks. By definition this means selling something. In other words, there was probably more than a little deception

going on. To paraphrase evolutionary biologist Robert Trivers, it is more than ironic that deception and its propagation were the files against which the tools of neocortical brain development were sharpened.² These Marks are probably conscious.

The Marks develop a science that shows them that the ratio of brain to body weight compared with time spent in infancy is a very curious thing. At the lower end of this scale is the chicken. Shortly after birth, perhaps within a few months, the chicken is an adult and starts laying eggs. A little up the scale are crows, who are given worms by their mother for perhaps the first year or two of life. They are smart enough to be trained to clean up garbage in a stadium after a football game. Then you have humans, who keep giving worms to their kids for a long time (some argue this lasts until the parents die). They are conscious.

Where

The underlying model of the brain in neurology is called the deficit lesion model, dating back over 100 years (which should scare you) to people like Paul Broca and Carl Wernicke with their aphasia diagnosis.³ A neurologist would still use this model today in assessing a stroke. This model was a good heuristic in the past but it is hopelessly underspecified in today's neuroscience.

Consider a patient with a hemispatial neglect syndrome from a right-sided cerebrovascular accident. Nothing in the left visual field is processed, so when a patient is looking at a picture of a house that is burning in the left wing, it will look identical to one that is not burning, but the patient *knows* you should leave this house if shown a picture of it. The patient seems to be processing information but not experiencing processing the information.

Consciousness is not localized; it is widely distributed, at least in the brain. Panpsychists say it is distributed throughout the whole universe. Research on things like this leads people to say that consciousness is simply the imperfect perceptions of the brain making an imperfect model of itself and the outside world. But speaking from an evolutionary point of view, perception is not about seeing reality as it really is: it is about having kids.

There are about 100 billion neurons in a human brain; 70 billion are in the cerebellum. The cells here seem to very linearly connected. Patients can lose their cerebellum and still be totally conscious (although they will have real issues with movement). Ten billion neurons are in the lower brain, leaving about 20 billion for the neocortex, where all the action is, from a consciousness point of view. This has led to the belief that consciousness is due more to the connections between neurons—the connectome.

How

There is an anesthetic explanation for *how* first put forth by Stuart Hameroff. It is based on microtubules—the scaffolding inside each cell. They are like tubes of the scaffolding on the outside of leaky condos, only in this case the walls of the tubes are made with peanut-shaped bipolar proteins called tubulin that are a helix, somewhat like the DNA molecule. A nice round cell like a hepatocyte doesn't need too much scaffolding to maintain its shape, but a neuron with its thousands of dendrites and an axon extending out millions of times the diameter of the neuron cell body needs lots of scaffolding to maintain this far-from-equilibrium shape. The thinking is that somehow the computation of the brain goes on here. This idea was given much credence when one of the world's foremost mathematicians, Roger Penrose, teamed up with Hameroff.⁴

Why

This is where the rubber hits the spiritual road. Some argue that why questions are best left to the philosophers, whose arguments never seem to converge the way that science tends to.

But the next time you are in an operating room with patients being put to sleep and waking up, you might ask yourself where they went. ■

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News We welcome news items of less than 300 words; we may edit them for clarity and length. News items should be emailed to journal@doctorsofbc.ca and must include your mailing address, telephone number, and email address. All writers should disclose any competing interests.

Reminder to submit GPSC portals 14070/71

Eligible family physicians are reminded to submit the GPSC Portal (G14070) or GPSC Locum Portal Code (G14071) at the start of the new year.

Submission of G14070 signifies that a family physician is:

- Providing full-service family practice services to patients and will continue to do so for the duration of that calendar year.
- Confirming doctor-patient relationship with existing patients through a standardized conversation or “compact.”

Submission of G14071 signifies that a family practitioner is:

- Providing full-service family practice services to the patients of host physicians who have submitted G14070, and will continue to do so for the locum coverage.

Submitting G14070/G14071 enables family practitioners to be eligible to bill the following fee codes:

- G14075 GP Frailty Complex Care Planning and Management Fee

- G14076 GP Patient Telephone Management Fee
- G14077 GP Allied Care Provider Conferencing Fee
- G14078 GP Email/Text/Telephone Medical Advice Relay Fee
- G14029 GP Allied Care Provider Practice Code

Additionally, submitting G14070 on an annual basis is a requirement of the new GPSC Community Longitudinal Family Physician Payment. Visit <http://gpscbc.ca/news/news/new-payment-support-longitudinal-care> for more information.

To avoid billing refusals, family practitioners need to bill G14070/71 following this example:

- PHN#: 9753035697
- Patient surname: Portal
- First name: GPSC
- Date of birth: January 1, 2013
- ICD9 Code: 780

For further details about G14070/G14071 in the GPSC Billing Guide–Portal, visit www.gpscbc.ca/what-we-do/longitudinal-care/incentive-program/billing-guides.

Research suggests no difference in morning versus evening dosing for warfarin

Patients taking warfarin to reduce the risk of stroke and pulmonary embolisms are often advised to take the medication in the evening. But does time of day really matter? A new study, conducted in Western Canada, shows evidence that morning versus evening dosing has insignificant bearing on how long the drug provides the most benefit for preventing adverse health events. Two hundred and seventeen adults who regularly used warfarin in the evenings were randomized to the trial, with about half switching to morning medication use for 7 months. Researchers measured the effectiveness of the drug by tracking the proportion of time that patients spent outside the range for its maximum effectiveness. Therapeutic changes did not significantly differ for patients who switched to morning administration. The clinical research team concluded that the time of day a patient takes the medicine has no effect on the stability of warfarin’s anticoagulant effect. Patients should take warfarin whenever regular compliance would be easiest.

The study, “The effect of warfarin administration time on anticoagulation stability (IN-Range): A pragmatic randomized controlled trial,” is published in *Annals of Family Medicine* and is available online at www.annfammed.org/content/18/1/42.



PHOTO: RONALD McDONALD HOUSE BC AND YUKON.

Ronald McDonald House expanding with new family room at Royal Inland Hospital

Ronald McDonald House BC and Yukon (RMH BC) is expanding with a new family room at Royal Inland Hospital (RIH) in Kamloops. Launched in partnership with Interior Health and Royal Inland Hospital Foundation, the new family room will offer a home-like retreat for parents and loved ones of all pediatric patients undergoing medical treatment for illness or injuries at RIH. The family room is slated to open in 2024. It will be situated next to the pediatric and neonatal intensive care units. For more information about RMH BC, visit www.rmhbc.ca.

Left: Family of Ronald McDonald House BC and Yukon.

Seeking external reviewers for BC guidelines

BC health care professionals and stakeholders are invited to participate as external reviewers of draft version of BC guidelines. Peer review is a critical component of the guideline development process. New and existing guidelines that have undergone substantive changes are subject to external review to make sure they are clearly written, practical, and free of errors.

The external review involves 1) regular mail sent to a random sample of BC physicians and relevant specialists, and 2) emails to a group of key partners in areas such as pharmacy, laboratory procedures, health authorities, public health, and professional colleges and associations. All feedback received is reviewed by the Guidelines and Protocols Advisory Committee (GPAC) guideline working group. For more information on the external review process, see the GPAC handbook at www2.gov.bc.ca/assets/gov/health/practitioner-pro/bc-guidelines/gpac-handbook/gpachandbook2017.pdf.

Earning continuing professional development credits

Physicians who act as external reviewers for BC guidelines may be eligible to receive credit toward continuing professional development or continuing medical education. For more information, see the Continuing Professional Development Credits page at www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/bc-guidelines/continuing-medical-education-cme-credits.

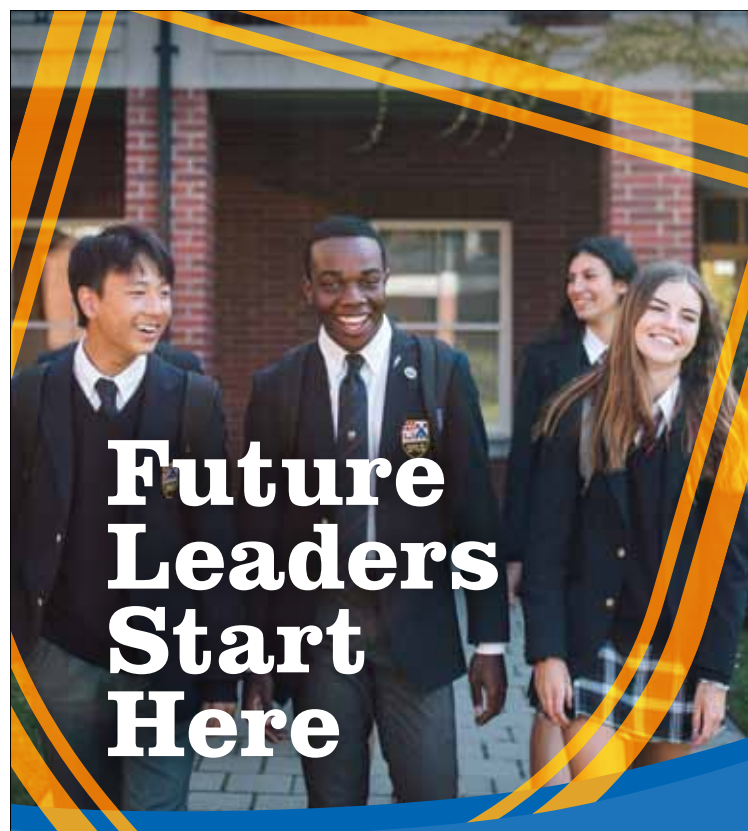
Lupus patients who take their medications at lower risk for type 2 diabetes

An Arthritis Research Canada study has revealed that patients with lupus who take their medications as prescribed have a reduced risk of developing type 2 diabetes compared to lupus patients who do not. There is no cure for the chronic autoimmune disease that affects several parts of the body, with symptoms changing often and varying from person to person. Medications for lupus primarily focus on easing a patient's symptoms and reducing inflammation. Hydroxychloroquine, a medicine used to treat malaria and for patients dealing with lupus flares, also has the ability to potentially reduce the risk of type 2 diabetes.

Using BC health data that include information on prescriptions, health care visits, and hospitalizations, Arthritis Research Canada research scientist Dr Mary De Vera and her team studied lupus patients over 4 years. They found that compared to those who did not take their medications as prescribed, namely hydroxychloroquine, those who did had a 39% lower risk of developing type 2 diabetes. From prior research, researchers know that an average of 43% to 75% of lupus patients do not take their medications as prescribed.

The study targeted type 2 diabetes as a known complication of lupus and is the first study to evaluate the link between nonadherence to antimalarial medication and lupus patients.

The study, "Adherence to antimalarial therapy and risk of type 2 diabetes mellitus among patients with systemic lupus erythematosus: A population-based study," is published in *Arthritis Care and Research* and is available online at <https://doi.org/10.1002/acr.24147>.



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WorkSafeBC resources for community physicians

In 2018, there were 155 753 work-related injuries reported to WorkSafeBC.¹ Many, if not most, community physicians will treat injured workers. There are several resources available to community physicians to help support them and their patients. Here are four avenues through which to get support from WorkSafeBC on work-related health conditions:

1. Outreach to community physicians: The Patient Care, Physicians and WorkSafeBC program

If your community clinic or a community physician conference is interested in learning more about WorkSafeBC billing, disability assessment, and management, or WorkSafeBC resources for injured workers, our outreach program—Patient Care, Physicians and WorkSafeBC—can come to you. WorkSafeBC provides outreach throughout BC and can tailor presentations to fit busy clinic schedules. The outreach can be delivered one on one, or if you practise or learn with a group of physicians, it can be offered to a group at your office, during hospital rounds, or over lunch or dinner. The modules are accredited (Mainpro+ certified and MOC Section 1) and are delivered by a group of regional medical advisors and billing specialists.

Knowledge of the function and history of WorkSafeBC can improve care of patients with work-related conditions. The modules were designed by content experts and review disability assessment and management, key occupational medical concepts to support safe return-to-work planning, and how community physicians can integrate the relationship between work and health into practice. With broad learning objectives that can be drawn from to meet your

unique needs, the outreach program covers a range of topics:

- Basic function and history of WorkSafeBC.
- Filling out forms (Form 8 and Form 11 for general practitioners).

Knowledge of the function and history of WorkSafeBC can improve care of patients with work-related conditions.

- Filling out reports (for specialists).
- Billing (can also be tailored to the needs of medical office staff). Doctors of BC and WorkSafeBC are currently negotiating a new fee guide with unique WorkSafeBC fee codes. The fee code and invoicing educational material will be updated when the new agreement is available.
- Assessing and managing disability (for all patients, including those with work-related health conditions).
- Bullying and harassment.
- Occupational exposures and occupational diseases.

Over the last 2 years, our outreach program has reached over 400 MOAs and physicians in over 10 different communities within the province.

If you would like to know more about this outreach or would like to arrange a learning opportunity, call 1 855 476-3049, email clinicalserviceevents@worksafebc.com, or contact a medical advisor in your nearest WorkSafeBC office.

2. Questions about your patient's claim or other WorkSafeBC issue

You can call our toll-free physician hotline at 1 855 476-3049 to leave a voice message or contact a medical advisor in your region. If you are calling about a claim, we will provide you with a fee code to bill for your time.

3. Questions about opioid management

You can call our physician hotline at 1 855 476-3049, which is staffed from 8:30 a.m. to 4:30 p.m., Monday to Friday. WorkSafeBC's addiction medicine physicians can speak with you about management of opioids, tapering, nonpharmaceutical strategies, harm reduction programs, community resources, and referrals.

4. WorkSafeBC's Annual Education Conference for Community Physicians

This year's conference will be held at Robson Square in Vancouver on 4 and 5 December 2020. We are partnering our annual conference with the Northwest Association of Occupational and Environmental Medicine. Planning is underway now; the planning committee is arranging physical examination workshops, our popular workshop on chronic pain management, and a worksite visit. ■

—Ernest Salcedo

WorkSafeBC Health Care Services Client Representative

—Celina Dunn, MD, CCFP, CIME

WorkSafeBC Manager of Medical Services

—Olivia Sampson, MD, CCFP, MPH, FRCPC, ABPM

WorkSafeBC Manager of Clinical Services

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This article is the opinion of WorkSafeBC and has not been peer reviewed by the BCMJ Editorial Board.

Health impacts of sea level rise on BC's coastal communities

Sea level rise due to melting ice sheets and thermal expansion of the ocean poses serious risks for coastal communities. Elevated sea levels erode shorelines and inundate low-lying coasts; these changes, in turn, allow high tides and storm surges to reach unprotected areas further inland. The perturbed coastal environment will lead to severe impacts on health.

In British Columbia, 80% of the population lives within 5 km of the coast, with the majority concentrated in Metro Vancouver and southern Vancouver Island.¹ Along the north coast, many settlements in Haida Gwaii, as well as Kitimat and Prince Rupert, are near sea level.¹

Displacement

Under current provincial estimations, sea levels around BC are projected to rise by 0.5 metre by 2050, and 1.0 metre by 2100, making many low-lying lands vulnerable to displacement from flooding tidal inflow and storm surge.¹

Sea level rise will have both acute and long-term effects on those now living near to shore. Acutely, flooding can lead to residential water infiltration and consequent mold growth, cold water immersion, drowning, and other injuries.² Over the longer term, loss of coastal land will lead to population displacement. Given the growing population and limited land availability in BC, displaced residents may find themselves competing with others for valuable land on elevated ground.

Displacement also has long-term health impacts. A 2017 study from the United Kingdom found a significant increase in the rates

of anxiety, depression, and posttraumatic stress disorder for individuals who were displaced as a consequence of flooding compared to those who experienced flooding but were not displaced.³ Inability to return home after a flood acts as a stressor that induces or exacerbates malnutrition, hypertension, and cardiac events.^{3,4}

In addition, much of the existing health infrastructure in BC will require relocation as a consequence of sea level rise, disrupting health services not only for people living near the ocean but those across the province who rely on these coastal facilities. Richmond and Delta hospitals in Metro Vancouver, which together serve a population of 300 000 people, are vulnerable to a 1-in-500-year storm surge even at today's sea level.⁵

Food security

Sea levels are predicted to rise by up to 1.2 metres in the Fraser River Delta by 2100,⁶ where BC's most productive farmlands are situated. In all, over 4600 hectares of farmland lie within 1 metre of sea level.¹ Given that BC currently produces 48% of all foods consumed in the province,⁷ flooding and saltwater intrusion pose serious food security risks. Adding to direct agricultural disturbances will be disruptions to ferry services and flooding of port terminals situated at sea level, which will affect food delivery to Vancouver Island and northern coastal communities that rely on maritime transport.

For fisheries-dependent communities, coastal erosion caused by sea level rise will lead to a loss of intertidal wetlands and upriver salmon breeding habitats, thereby reducing BC's salmon and shellfish populations. Warming waters that

lead to sea level rise also threaten BC's wildlife salmon runs. This will particularly impact Indigenous communities and others who cultivate berries and harvest fish and shellfish.

Water security

Across BC, 28.5% of residents rely on groundwater for drinking, irrigation, or industrial needs.⁸ As rises in sea level continue, the likelihood of saltwater infiltrating groundwater will increase and reduce the availability of freshwater for coastal communities. Along BC's Gulf Islands, rising sea levels are already gradually causing salt water intrusion of existing

freshwater wells and aquifers.⁹ Although the water supply for much of the Lower Mainland is located outside of coastal floodplains, sea water may damage wastewater treatment facilities, leading to spread of waterborne diseases such as *E. coli* or *salmonella*.

While its procession is gradual, sea level rise resulting from global climate change is occurring along the densely populated BC shoreline, posing both foreseeable and harder-to-foresee health risks for the province's coastal residents. While sea level rise may look like an environmental issue, it has the potential to impact many of the determinants of health, affecting everything from access to health care services and safe and nutritious food to mental health. ■

—Kevin Liang, BSc

—Tom Kosatsky, MD, MPH

**In British Columbia,
80% of the population
lives within 5 km
of the coast.**

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This article is the opinion of the BC Centre for Disease Control and has not been peer reviewed by the BCMJ Editorial Board.

CME calendar

Rates: \$75 for up to 1000 characters (maximum), plus GST per month; there is no partial rate. If the course or event is over before an issue of the *BCMJ* comes out, there is no discount. **Deadlines:** ONLINE: Every Thursday (listings are posted every Friday). PRINT: The first of the month 1 month prior to the issue in which you want your notice to appear, e.g., 1 February for the March issue. The *BCMJ* is distributed by second-class mail in the second week of each month except January and August. **Planning your CME listing:** Advertising your CME event several months in advance can help improve attendance; we suggest that your ad be posted 2 to 4 months prior to the event. **Ordering:** Place your ad at www.bcmj.org/cme-advertising. You will be invoiced upon publication. Payment is accepted by Visa or MasterCard on our secure online payment site.

CME ON THE RUN

VGH and various videoconference locations, 3 Apr–5 Jun (Fri)

CME on the Run sessions are held at the Paetzold Lecture Theatre, Vancouver General Hospital, and there are opportunities to participate via videoconference from various hospital sites. Each program runs on Friday afternoons from 1 a.m. to 5 p.m. and includes great speakers and learning materials. Dates and topics: 3 Apr (infectious disease and travel). Topics include Herpes zoster, pneumococcal and HPV vaccine update; Prevention and treatment of motion sickness; Infections in pregnancy; Practical approach to fever of unknown origin in the returning traveler; Antibiotics stewardship; Battling the superbug: How to approach MRSA; Insect- and tick-borne rashes and diseases; Management of infectious diarrhea: What and how to treat. The next sessions are: 1 May (prenatal, pediatric, and adolescents); 5 Jun (internal medicine). To register and for more information visit ubccpd.ca, call 604 675-3777 or email cpd.info@ubc.ca.

MINDFULNESS IN MEDICINE WORKSHOP FOR PHYSICIANS AND PARTNERS

Tofino, 17–20 April (Fri–Mon)

Please join Dr Mark Sherman and your physician colleagues for a 4-day workshop learning the foundations of mindfulness theory and practice for yourself, your partner, and your patients! Learn about the latest research, neuroscience, and applications, as well as practising several meditation skills to use in your own life to build resilience, wellness, and self-compassion. This workshop is accredited for 16 Mainpro+ credits through the College of Family Physicians of Canada. For more information and to register please go to www.livingthismoment.ca/events or contact mark@livingthismoment.ca.

HEALTHCARE PROVIDERS CONFERENCE

Victoria, 14 May (Thu)

Join us for an evening of educational sessions at LifeLabs 4th Annual Healthcare Providers Conference to be held at the beautiful Oak Bay Beach Hotel, 1175 Beach Drive. If you

think of laboratory medicine as a black box, or if you would like to know more about ordering and interpreting lab testing, or if you'd like to connect with lab medicine specialists, this is the conference for you. Topics will be of interest to GPs and specialists, nurse practitioners, naturopathic doctors, and allied health care providers—particularly those providing primary care and ordering and interpreting lab tests. Our PhD and MD laboratory medicine staff includes specialists in biochemistry/toxicology, hematology, microbiology/infectious diseases, and genetics. They will share their expertise through formal presentations and also be available for informal discussion before and after the sessions. Presentations will use a case-based format to address clinical topics in laboratory test selection and interpretation. A complete list of presentation topics will be posted to our website closer to the meeting date. Conference registration includes a free gourmet buffet dinner and nonalcoholic beverages. This educational event may qualify up to 2 hours of unaccredited group learning activity. Registration is free. Sign up now as space is limited: www.lifelabs.com/annual-conference.

TROPICAL & GEOGRAPHIC MEDICINE INTENSIVE

Vancouver, 4–8 May (Mon–Fri)

This is the 7th annual CME accredited course for physicians, medical trainees, public health practitioners, nurses, and other health care workers who intend to practise in the tropics, in resource-limited settings, or who require an update on infectious, parasitic, and other major tropical diseases. The course will be held at the UBC Vancouver campus. Through interactive lectures, small-group case-based discussions, and practical laboratory teaching, attendees



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will learn a clinical approach to the evaluation and management of tropical diseases, practical laboratory skills with a focus on the identification of parasites important for the diagnosis of tropical diseases, and public health principles and applications including outbreak management. Early registration rate effective until 6 April 2020. Register early on the course website as space is limited. More information at www.spgh.ubc.ca/continuing-education/tgm2020. Contact spgh.ce@ubc.ca.

DIABETES DIRECTORS SEMINAR Vancouver, 8 May (Fri)

The Endocrine Research Society is pleased to present the 32nd Diabetes Directors Seminar, an annual, UBC-accredited gathering of leading diabetes experts and caregivers across British Columbia. Join us at the Sandman Vancouver City Centre Hotel for a full-day presentation series covering the latest and most pertinent aspects of diabetes therapeutics and clinical care. Target audience: specialists and family physicians with an interest in diabetes care, nurses, dietitians, pharmacists, and other diabetes educators responsible for diabetes management within their own groups and communities. Register now as space is limited. Online registration: www.endocrineresearchsociety.com/events/32nd-annual-diabetes-directors-seminar. For more information or registration questions please contact Eric Chow at the Endocrine Research Society, endocrine.research.society@gmail.com, 604 689-1055.

CANADIAN CONFERENCE ON PHYSICIAN LEADERSHIP

Vancouver, 29–30 May (Fri–Sat)

The Canadian Conference on Physician Leadership—Accepting our Responsibility as Physician Leaders will be held at the Hyatt Regency Hotel. This 2-day educational event brings together physician leaders from across Canada and around the globe and is designed to engage and educate physician leaders at all levels. Take advantage of our four 2-day intensive and interactive preconference courses (27–28 May). For more information email carol@physicianleaders.ca, or visit www.physicianleadershipconference.com.

GP IN ONCOLOGY TRAINING Vancouver, 14–25 Sep and 1–12 Feb (Mon–Fri)

BC Cancer's Family Practice Oncology Network offers an 8-week General Practitioner in Oncology education program beginning with a 2-week introductory session every spring and fall at BC Cancer–Vancouver. This program provides an opportunity for rural family physicians, with the support of their community, to strengthen their oncology skills so that they can provide enhanced care for local cancer patients and their families. Following the introductory session, participants complete a further 30 days of clinic experience at the Cancer Centre where their patients are referred. These are scheduled flexibly over 6 months. Participants who complete the program are eligible for credits from the College of Family Physicians of Canada. Those who are REAP-eligible receive a stipend and expense coverage through UBC's Enhanced Skills Program. For more information or to apply, visit www.fpon.ca, or contact Jennifer Wolfe at 604 219-9579.

About BCMJ bags

The BCMJ avoids bag use whenever possible, but when we need to use them, rest assured that the bags are certified compostable. They are plant-based and will compost in your backyard compost bin.

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2. Mollison PL. *Blood Transfusion in Clinical Medicine*. Oxford, UK: Blackwell Scientific Publications; 2004. p. 78-80.

3. O'Reilly RA. Vitamin K antagonists. In: Colman RW, Hirsh J, Marder VJ, et al. (eds). *Hemostasis and Thrombosis*. Philadelphia, PA: JB Lippincott Co; 2005. p. 1367-1372.

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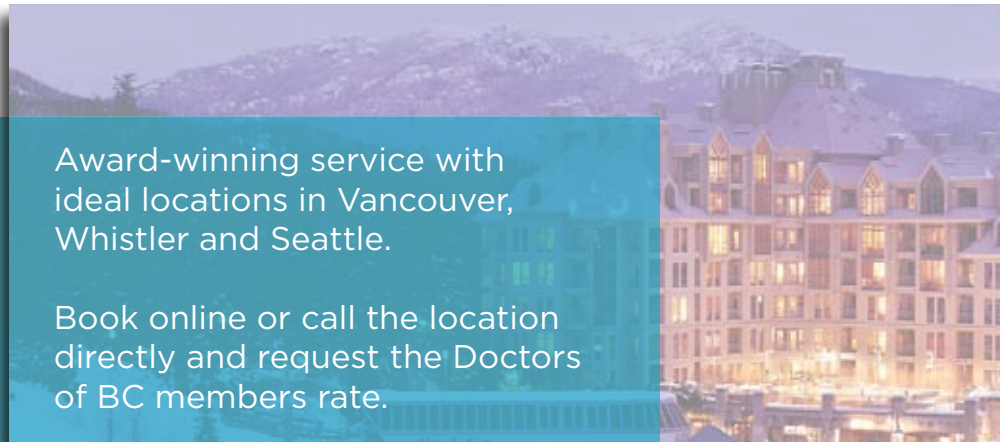
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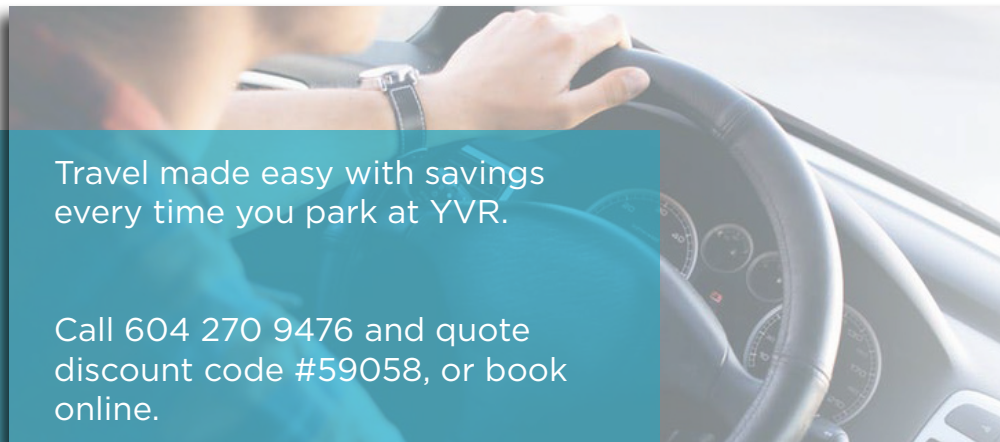
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