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Addressing the COVID-19 challenge through research and collaboration

On January 30, 2020, the World Health Organization (WHO) declared the novel human coronavirus, also known as COVID-19 (SARS-CoV-2), a Public Health Emergency of International Concern. On March 11, it was labelled as a pandemic. This worldwide phenomenon has threatened our collective health, changed the way we interact with our community and placed a large burden on our healthcare system.

More than eight months in, much is still unknown about the virus and its long term impacts on health and society. With death tolls rising and no vaccine, swift and deliberate action is needed to address this global emergency.

The University of Calgary and Cumming School of Medicine (CSM) are working in all disciplines to address this crisis. In addition to our dedicated research strategy for infections, inflammation and chronic diseases in the changing environment, clinician-researchers from across the school have quickly mobilized research to impact positive change through basic science, clinical trials and initiatives to protect everyone, including our front-line workers. The following highlights some of the activity CSM is leading.

Addressing emerging needs through CSM's Impact Fund

COVID-19 is affecting our world in unprecedented ways – our understanding of the disease and our needs are rapidly evolving in response to unforeseen obstacles and new discoveries. Gifts to the CSM Impact Fund support important research and education priorities within the Cumming School of Medicine, including our response to COVID-19 and the important core infrastructure that supports this work.

The CSM Impact Fund is critical to our work as it allows us to be nimble, providing essential funding for promising larger projects and seed money for smaller projects that may have large impacts. Community support to this fund will have untold impact to mitigate the rapid spread of this disease, and its consequences on people and communities.

Refurbishing level-three lab space for critical COVID-19 research

Most laboratories in Canada are equipped to study pathogens that pose moderate risk. These laboratories are designated as level two. However, there are pathogens like COVID-19 that are more deadly and require a level three facility – one with the necessary infrastructure in place to

ensure pathogens cannot escape or infect researchers through the air.

There are very few level three facilities in Canada, but we have one at UCalgary. It was shut down 10 years ago but retains the proper containment equipment (i.e. biosafety cabinets), venting, reinforced entry and exit points, and extra safety requirements to carry out this work. Funding from a variety of sources – including philanthropic funding – is helping to re-open this facility. Further funding is desperately needed to update equipment and staff this facility so that it can be used for COVID-19 research.

UCalgary has some of the world's best scientists poised to use their skills and grant dollars to tackle this public health crisis. However, in absence of a functional level three facility, UCalgary cannot work with COVID-19 or with tissue samples infected with COVID-19. This hinders our ability to slow spread as we are not able to develop and test treatments in the lab or examine how the virus kills.

Recommissioning this lab will enable critical work needed to help people survive infection. Philanthropic support from our community to equip and staff this facility will allow these researchers to come together with colleagues around the world, share information to better understand COVID-19, and further develop therapies to combat this and other infectious diseases.

Developing a vaccine to immunize against COVID-19

It is widely believed that the easiest way out of the COVID-19 crisis lies in the development of a vaccine. Without one, people will continue to get ill, and sustained or intermittent social distancing may be required into the foreseeable future.

UCalgary is part of a new Canadian initiative working to create such a vaccine. Comprising labs in Calgary, Ottawa and Montreal, this vaccine could deliver key information to a person's immune system about what COVID-19 looks like and how to stop it. The proposed platform for the work – recombinant vesicular stomatitis virus (rVSV) platform – is the same system that was used to develop the first and only licensed vaccine for Ebola virus, which has been safely delivered to more than 200,000 people and credited with helping to end two recent outbreaks in Africa.

Similar rVSV-vectored vaccines have been shown to elicit strong, protective immune responses against other viral pathogens, including ones responsible for two large global pandemics over the past 20 years: SARS-CoV (SARS) and Middle Eastern Respiratory Virus (MERS).

Because this platform has demonstrated success – and boasts a strong safety and efficacy profile – there are already well-established protocols to manufacture VSV-based vaccines that are affordable and scalable, both essential to meet global demand. The UCalgary team has more than 10 years of experience developing these kinds of vaccines and related vectors for treating cancer.

Within 12-16 weeks, the team will determine if a lead vaccine candidate warrants testing, with an eye to launching a clinical trial in as soon as seven months of starting this project. This work is planned for the University of Calgary Level 3 laboratory (above).

Supporting human factors research and simulation for COVID-19 preparedness

The Ward of the 21st Century (W21C) Research and Innovation Centre is an initiative based in the University of Calgary's O'Brien Institute for Public Health and the Calgary Zone of Alberta Health Services (AHS). W21C serves as a research and beta test-site for exemplary hospital design, novel approaches to healthcare delivery, human factors research, and innovative medical technologies. They have a proven

track record for infection prevention (including Ebola) which continues to contribute positively to healthcare practices and processes worldwide, including those keeping healthcare workers safe on the front lines of COVID-19. Funding will enable us to learn and respond now and inform better processes for future health emergencies.

W21C is responding to the COVID-19 pandemic crisis through several rapid research initiatives in infection prevention and control, with a goal of identifying actionable strategies to immediately improve the health and well-being of our local, national and international communities. W21C researchers are focusing on evaluating and reducing the potential for transmission of COVID-19 between patients and healthcare workers, in both primary and acute care settings, through:

- Workspace re-design recommendations through simulation and human research (e.g. donning and doffing procedures in hospitals for personal protective equipment to protect our frontline staff).
- Running simulations to understand how to protect people during patient triage and swabbing for COVID-19 on-site in primary care centres (which may include technology evaluation for new rapid testing prototypes).
- Implementing rapid, just-in-time education for care providers to get up to speed on proper protocols (including when to wear masks and how to reduce contamination in open areas).
- A hand hygiene visualization project to measurably enhance hand hygiene compliance by both healthcare providers and patients/families, to reduce the spread of infections (in hospitals and in the community). This two-year project includes installation, maintenance, and research in hospital and community settings (e.g. primary care facilities, airports).

Delivering medical supplies safely to First Nations and remote communities

The pandemic has heightened our awareness of deficiencies in health infrastructure and testing opportunities for Indigenous and remote communities. Indeed, the COVID-19 pandemic is a call for fast-tracking healthcare innovation and accelerating healthcare reform for our most vulnerable communities and populations.

UCalgary, through W21C, is partnering with the Southern Alberta Institute of Technology (SAIT) to support significant COVID-19 needs for First Nations and rural and remote communities during the pandemic. In partnership with three First Nations communities (Nakoda (Stoney), Eden Valley and Big Horn), we are testing and developing methodology to use Remotely Piloted Aerial Systems (RPAS) – a.k.a. drones – to shuttle medical supplies and testing specimens between remote communities and the city of Calgary. The proof of concept project will be used to develop a roadmap for future RPAS-based medical delivery operations.

Mapping immune responses to combat severe COVID-19

A team of UCalgary experts in single cell genomics and acute respiratory distress syndrome (ARDS) are partnering to examine how the body's immune defense response to COVID-19 may be contributing to the severe lung damage that kills patients.

Using single cell RNA-sequencing of blood samples from COVID-19 patients, they seek to identify all of the immune cell types that have been mobilized to fight infection. Understanding this process might reveal better therapeutics targets to repurpose current medicines rapidly or design new ones.

This data will be compiled and shared through an online interactive platform – or ‘atlas’ – which can be easily accessed by researchers and physicians from around the globe to inform the development of more effective drug treatments to combat this disease. It can also be further mined and possibly inform treatment and understanding for future viral infections.

Exploring human immune system responses to protect our most vulnerable

Some people who test positive for COVID-19 become severely ill, while others seemingly experience few or no symptoms. Dr. Marv Fritzler believes that differences in our immune responses to the virus may be a key to better understanding how to monitor disease exposure and predict short-term and long-term outcomes.

Dr. Fritzler says it is possible that asymptomatic patients have natural or acquired immunity to this virus. He is working to develop tests that look at antibodies and virus molecules to more completely understand how our immune response is working before and after exposure. Research will include a review of existing lab tests and developing new ones to see how they can help fill a gap in our understanding. A better understanding of natural and acquired immunity may help inform public policy and allow us to focus our limited resources on the patients who will need medical help to recover.

Enhancing CATCO-SOLIDARITY WHO clinical trial: Alberta sites

UCalgary and UAlberta researchers are joining partners across Canada and around the world to fight COVID-19. CATCO is the Canadian arm of the World Health Organization’s (WHO) SOLIDARITY trial, a multinational project to rapidly investigate novel treatment options for patients hospitalized with this devastating disease.

This ‘mega-trial’ will help us determine – on a global level – the potential of proposed treatments in the fastest scientifically-sound way. Scientists will be able to quickly decide which drugs to use by testing them in a variety of situations. It will help us understand the differences in patients who are receiving treatment, and ensure the treatment is the reason they recover, not their body’s own immune responses.

This collaboration offers some patients in our province with therapeutic opportunities they may not have had otherwise and ensures that we will learn quickly which treatments are more and less effective. While this is a WHO-led initiative, additional funding to this project will allow us to procure essential equipment, enroll more Alberta patients, and hire more full time coordinators to undertake this work.

Harnessing data for timely decision-making

Data plays a critical role in health, helping to visualize trends and determine strategies to prevent, diagnose and treat conditions. The Cumming School of Medicine’s Centre for Health Informatics (CHI) – a designated WHO collaborating centre – is contributing to city and provincial measures to curb the spread of COVID-19. Under the direction of UCalgary’s COVID-19 Task Force, our team of researchers is partnering with Alberta Health Services (AHS) and Alberta Health (AH) to provide up-to-date data visualization, epidemic modelling and healthcare capacity modelling. Their work supports clinical, policy

and governmental decision-making, ensuring timely and evidence-based decisions can be made when they are most urgently needed.

Data Visualization

CHI has created a COVID-19 dashboard – www.CHI-CSM.ca – to provide Canadian researchers and policy-makers with a tool to track and compare COVID-19 cases across a number of variables, including country and province, age, method of transmission and speed of spread. Using public and provincial data sources, it is a way to see which specific policies are associated with flattening the curve and what the association is between frequency of testing and incidence of containment.

COVID-19 Epidemic Modelling

A team with personnel from UCalgary, AHS and AH is using provincial data to provide daily estimates on the prevalence of COVID-19 in Alberta, as well as the effectiveness of provincial testing efforts. Base models will be modified to assess the impact of social distancing policies on disease prevalence – here and around the world – and predict the likelihood of severe outcomes based on individual and geographic factors.

Clinical epidemiology support for COVID-19

Working with up-to-date case incidence data from government agencies, CHI is linking relevant databases to compare laboratory- and clinically-confirmed COVID-19 cases with seasonal influenza cases. This will help us to understand similarities and differences between these diseases and plan for upcoming healthcare needs (e.g. hospital beds) – allowing us to learn from this pandemic and better preparing us for the future.

Serological tracking to inform global public health, economic policy and medical research

Serologic tests look for the presence of antibodies in the blood. SeroTracker is a global project to synthesize data from COVID-19 serological testing efforts worldwide to inform public health, economic policy and medical research. The CHI is working with colleagues at universities including Oxford and Harvard to build the world's best up-to-date repository of seroprevalence information – their publications, dashboards and advisory work are shaping policy and research in Canada and worldwide. Philanthropic support will help to run SeroTracker at UCalgary.

Health Link Data Transmission Study

The CHI team is working to transform over 80,000 paper COVID-19 triage intake documents from AHS into useable digital data ready for analyses. Custom optical character recognition code is being developed – this technology will be used for this project, and will be available for other similar transformation projects to support healthcare services and research.

Focusing on the most promising solutions

The world is racing to find a vaccine to protect and immunize people from COVID-19. A CSM researcher is proposing a study that would allow only the most promising candidate vaccines to proceed into clinical trials, thereby saving precious time and resources. His project involves studying multiple subsets of COVID-19-specific T cells by cytokine flow cytometry – an area supported by CSM core facilities and one where we have advanced expertise – to understand differences in patients with mild/asymptomatic disease and patients who need hospitalization and ICU care. His goal is to determine which subset of T cells is most likely to show if a given COVID-19 vaccine is working, helping investigators around the world to focus their research and find a solution to this health crisis.

Safeguarding our city against future waves of infection

Researchers at UCalgary are examining Calgary wastewater to help track the spread of COVID-19 across the city and mitigate future waves of disease. COVID-19 is an enterovirus – one that lives in the gut and is excreted in the stool. Working with the City of Calgary, researchers are looking at wastewater samples from different areas across the city to monitor, in real time, how many citizens are infected with COVID-19 and where they live. This novel collaboration allows us to understand potential for a second wave of infections and help guide policy decisions around adding or lessening restrictions.

Investigating treatment using protein blockers to reduce replication and inflammation

COVID-19 is showing up in lungs, blood vessels, heart and kidneys, and can lead to organ failure and death. Seemingly important to this disease progression is the cytokine storm, where the body produces too many small signals (chemicals and proteins) that cause inflammation. One thing each of these organs have in common is the presence of endothelial cells, which express a protein called pannexin – something studies have shown is important in inflammation, cell death and in allowing some types of viruses to enter cells.

UCalgary is home to some of the world's leading experts on pannexin biology. Collaborating with Dr. Jon Audia – an expert in infectious disease and lung inflammation with access to the level three Laboratory of Infectious Disease in Mobile, Alabama – they're looking to take a pre-clinical study testing pannexin blockers and their impact on virus replication and virus-induced inflammation to a clinical trial setting for the prevention of spread or reduction of COVID-19 symptom severity.

Mitigating the effects of COVID-19 on mental health

The COVID-19 pandemic is expected to have profound, long-term impacts on mental health. Fear of contracting the virus, social isolation and economic displacement are potential environmental triggers for increases in anxiety, depression and other mental health symptoms. Many individuals already suffering from mental illness are experiencing a disruption in their usual care due to the cancellation of outpatient services. Research is critically needed to mitigate the anticipated mental health effects of the current pandemic and learn about the impact of catastrophic environmental events like COVID-19 on the brain.

The Mathison Centre for Mental Health Research & Education – part of UCalgary's Hotchkiss Brain Institute – is dedicated to advancing research and education on early identification, treatment and prevention of mental illness. Our researchers have rapidly developed a number of innovative projects designed to better understand and respond to the short, medium and long-term mental health consequences of the current crisis. Results from these studies will provide healthcare providers and policy-makers with vital information that will: enable them to develop and evaluate treatments, direct mental healthcare service planning, evaluate the impact of current public health measures, and inform implementation of public health measures during recovery and (if necessary) during subsequent COVID-19 pandemic waves.

Investigating the mental health impact of pandemic on vulnerable children and youth

A multidisciplinary group of UCalgary researchers from the Faculties of Arts, Social Work and Medicine is investigating the mental health impact of COVID-19 on a large sample of children who are particularly vulnerable. This cohort includes children who already suffer from chronic pain or a pre-existing anxiety disorder, as well as children who have a parent with mental illness. Already underway, this longitudinal study will offer recommendations for practice, policy development and health emergency planning.

Brief therapy and mental health supports for emerging adults

Emerging adulthood – the developmental phase between adolescence and adulthood – is the highest risk period for the onset of mental illness, with approximately 50 per cent of mental illnesses beginning during this time. The COVID-19 pandemic will further increase the risk for this vulnerable age group at a time when our healthcare system is already strained and access to support services is reduced.

CASTOFF-YYC (Coronavirus Anxiety and Stress Therapy Online For Families, Youth, Young adults and Care providers) is a partnership between UCalgary and Alberta Health Services seeking to expand access to mental health services. Researchers are developing and testing a brief, online version of evidence-based psychotherapy for adolescents, young adults and caregivers who are struggling to cope with distress caused by COVID-19, with results rapidly disseminated to front-line practitioners. An effective online therapy targeting the needs of emerging adults will address a critical gap in treatment, both now and beyond the current crisis.

Preparing our physicians and healthcare professionals to combat COVID-19

Albertans are currently facing the possibility of our healthcare system being overwhelmed by COVID-19 cases. We must act now to equip physicians and other healthcare professionals – regardless of their typical scope of practice – with the necessary knowledge, skills and competencies to treat COVID-19 patients within various clinical environments.

CSM's Office of Continuing Medical Education & Professional Development has mobilized to provide just-in-time training, education and resources to these physicians and healthcare professionals. Offerings include webinars, online training modules and other resources that leverage established in-house people, processes and infrastructures to support up-skilling and knowledge dissemination. The CME team has already seen a high level of participation in our current COVID-19 related offerings, indicative of the need and desire for this education and training. The support of our community will allow us to continue to offer these services free-of-charge, contributing to a larger and better equipped front line to serve the health care needs of all Albertans during this critical time.

Fueling progress through philanthropy

COVID-19 is an unprecedented global emergency which will only change through research and collaboration. Your support of the Cumming School of Medicine will fuel discovery that may help to turn the tide on this pandemic. There has never been a more urgent need for CSM to collaborate with our community and peers from around the world. Join us and, together, we will create the future of health.

For further information, please contact:

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Effecting change through CIHR funding

The University of Calgary is a research powerhouse whose investigators are bringing evidence-based scholarship to this public health emergency. In addition to the projects above, we are making significant contributions to COVID-19 research through five new federal government (CIHR) grants to accelerate the development, testing and implementation of countermeasures to reduce the spread of this disease, and protect people and communities. These projects include:

Rapid diagnostics

Dr. Dylan Pillai, MD, PhD, is leading a team pursuing development of point-of-care testing for use in pandemics like COVID-19. They are working to create a tool that will enable health-care workers to rapidly identify the virus using portable, bedside testing methods. This will allow testing to be done outside of hospitals and labs, preventing further transmission and rapidly isolating infected individuals.

Assessing Alberta's preparedness and response

A team led by Dr. Myles Leslie, PhD, is evaluating how COVID-19 preparedness and response policies are being transmitted to, and implemented in, hospitals and family doctors' offices in Alberta. Through interviews with public health workers, and site visits with front-line clinicians, the team will assess how policies, protocols, and lines of communication are functioning. This research will create a detailed description of how policies are formed, transmitted, and put into action as the outbreak develops in Alberta. Working alongside public health professionals and clinicians, the team will help identify opportunities for improving response efforts in real time, and for future public health emergencies.

Impact of coronavirus on children and their families

Dr. David Nicholas, PhD, and his team will assess how the COVID-19 outbreak impacts health-care delivery for pediatric patients and their families. Children with pre-existing health conditions are a highly vulnerable population during an outbreak. Those being treated for an illness are at risk for a wide range of concerns including: isolation, anxiety around infection, fear, financial hardship for their families, reduced access to services, and challenges related to stigma, and social acceptance. This study will offer recommendations for practice, policy development and health emergency contingency planning.

Global study to improve diagnosis and treatment for children infected by COVID-19

Very little is known about how COVID-19 affects children and what the best treatment is for those who are infected with the virus. A team led by Dr. Stephen Freedman, MD, Alberta Children's Hospital Foundation professor in child health and wellness, and an international group of pediatric emergency medicine clinicians and researchers are hoping to change that.

The team is working to identify the differences in symptoms between children infected by SARS-CoV-2 and other respiratory viruses such as influenza, allowing them to tailor testing and treatment approaches to achieve the best results. They will also look at long-term outcomes of those infected with SARS-CoV-2 to determine whether it leads to any chronic conditions, and evaluate the impact regional policies on child health. Information gathered in the study – from 50 sites in 14 countries – will be shared in real-time with clinicians, researchers and public health agency partners throughout the world including the Public Health Agency of Canada, the Centers for Disease Control and

Prevention in the United States and the World Health Organization. The Alberta Children's Hospital is lead site for this effort and data collection is already underway.

Educating and empowering Canadians

A fifth project led by Dalhousie University in Nova Scotia includes 13 UCalgary faculty and staff members. This study will develop a national campaign to educate the Canadian public on coronavirus and COVID-19, and empower them to make informed health-care decisions. The team will be led by Dr. Jeanna Parsons Leigh, PhD, assistant professor at Dalhousie University and research assistant professor in the departments of Critical Care Medicine and Community Health Sciences at the CSM, and a member of the O'Brien Institute for Public Health.