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We live in a time when multiple major societal challenges are emerging. Addressing them requires scientific effort – not only to answer the questions they raise but also to find solutions.

We can think about climate change, which is observed at a faster pace in Northern Canada than many other places. Or we can think about pandemics, which seem to happen more frequently due to the increase in human population and mobility. Also, many issues concerning the health of our populations are still relevant – and the challenges of achieving sustainable health will need to be answered. Furthermore, secure and sustainable access to healthy food remains a challenge in many parts of the world, including in Canada.

Canada has gained a world wide reputation as a leader in numerous fields, such as telecommunication technologies, new materials, neurosciences, infectiology and vaccine development, artificial intelligence and climate change studies, to name a few. Thanks to investments from the Canada Foundation for Innovation (CFI), research teams from Université Laval and throughout Canada have risen among the world's research elite. With research equipment and infrastructures funded by CFI, our research teams have pushed the limits of knowledge.

Yet to keep our place in research across the world, Canada needs to continue to invest in tools, equipment and infrastructure so that our researchers can continue to make new discoveries, create and innovate. At Université Laval, we believe it is essential to support researchers at every step of their career path. We especially think it is important to fully equip young researchers – tomorrow's experts – and to support them in the pursuit of their scientific program.

In addition, it is crucial for Canada to establish links with other major international networks and share our unique research infrastructure to better respond to current and future societal challenges. Often, what we can achieve together goes beyond what we do alone.

In our view, partnership between Canadian academic institutions and other organizations across the world is absolutely necessary to solve the most crucial international societal issues. Also, many countries cannot develop the major infrastructure needed to solve such issues.

By unifying our forces, countries can innovate and offer access to shared infrastructure to all researchers. But even more important is the partnership across disciplines, sectors and fields to look simultaneously at complex problems from multiple analysis angles.

Partnerships between academic institutions, governments and industries are also pivotal in order to allow for the adoption of innovations by communities. Without this proximity, technological and knowledge transfer is harder and longer, and the solutions suggested might not fit the needs of the end users.



The new home for Canada's Global Nexus at McMaster Innovation Park will integrate world-class biomedical research infrastructure, front-line clinical care facilities, multidisciplinary education and workforce training space, plus co-located public and private pandemic preparedness teams. **MCCALLUMSATHER, LING STUDIOS**

How to fight a pandemic

Marshalling a response to COVID-19 and future health risks at Canada's Global Nexus for Pandemics and Biological Threats

When the first COVID-19 case in Canada was identified in January 2020, McMaster University was uniquely equipped to immediately begin fighting it on multiple fronts, thanks in large part to early and ongoing investment by the Canada Foundation for Innovation (CFI). The agency has enabled McMaster – Canada's most research-intensive university – to attract and retain world-class scientists and to build the infrastructure they need to carry out cutting-edge work.

McMaster was ideally positioned to help lead Canadian efforts to isolate and purify the SARS-CoV-2 virus from patients soon after some of our country's first COVID-19 cases were identified. The university's reputation as a leader in infectious disease research, its Level 3 containment facilities for studying serious pathogens, and being home to the country's only bat-breeding laboratory (led by neuroethologist Paul Faure) allowed Karen Mossman, a virologist and McMaster's vice-president of research, to recruit some of Canada's top talent to her lab.

Like professional athletes, outstanding scientists have the power to choose the team with the greatest championship potential. McMaster has scored big with recruits, including then post-doc Arinjay Banerjee, who joined Dr. Mossman's laboratory within the Michael G. DeGroote Institute for Infectious Disease Research (IIDR) – both of which have been built with CFI funding. Dr. Mossman and her team had been working on virus host interactions, and Dr. Banerjee had developed the special skills necessary to culture and grow coronaviruses, which are notoriously finicky. And early in 2020, their expertise was suddenly in high demand.

"When our clinical colleagues in Toronto started to see patients who were COVID-19 positive, our team was able to work collaboratively to isolate the virus out of patient samples," says Dr. Mossman, adding that a \$1.5-million award from CFI's Exceptional Opportunities Fund, specifically for COVID-19 research, enabled her to upgrade the Level 3 facility to work on SARS-CoV-2 – and to move forward even more quickly on the COVID-19 front.

Dr. Mossman points to McMaster's collaborative approach to research as pivotal to what happened next, after her McMaster colleague, Andrew McArthur, an expert in bioinformatics, took up the baton, sequencing and verifying the genome of the SARS-CoV-2.

From there, says Dr. Mossman, it was all about growing the virus and sending it to other Canadian institutions with Level 3 facilities, recognizing that the more scientists there were investigating its different aspects, the better possible outcomes for everyone around the world.

McMaster was at the forefront of the field long before anyone had ever heard of COVID-19. In fact, discoveries made by McMaster professor emeritus Frank Graham nearly five decades ago are used in AstraZeneca and Johnson & Johnson vaccines. And Gerry Wright, founding director of the IIDR, and the institute's trans-disciplinary team have been leading the fight against superbugs for decades.

According to Dr. Wright – who chose to build his research program in Canada in large part because

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Dr. Karen Mossman
Virologist, Vice-President of Research, McMaster University

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Infectious disease expert and Lead of Canada's Global Nexus for Pandemics and Biological Threats

of the CFI's creation – the most innovative discoveries come when discipline-specific boundaries are eliminated.

"Since its inception, the IIDR has prided itself on multidisciplinary work, from biomedical research and mathematical modelling to population biology, anthropology and engineering," Dr. Wright says. He notes that it is this collaborative approach that allows the institute to attract and retain global talent, including researchers like Jonathan Stokes, the newest member of Dr. Wright's group, who was lured from MIT to continue his research using artificial intelligence to identify new antibiotics. None of this would have been possible without the support of the CFI, Dr. Wright adds.

Building on this track record, in 2020 McMaster announced it was marshalling this deep well of expertise to fight COVID-19 and prepare for the inevitable pandemics to follow with the creation of Canada's Global Nexus for Pandemic and Biological Threats.

"Not only do these big infectious disease problems require well-resourced biomedical research to deliver new vaccines and new drugs, they also require a societal response," says Dr. Wright, who is the inaugural lead of Global Nexus.

"The impact on the economy, on society as a whole, on information, on trust, really becomes an issue, and we can't solve one problem without solving the others," he says. "The objective of Global Nexus is to integrate all these disciplines and bring the best scholar-

ship, the best research tools and infrastructure, and the best minds to bear on these big problems, because the current pandemic is not going to be the last one."

McMaster researchers are mobilizing their knowledge to better serve Canadians. As co-lead of the Canadian Network for Modelling Infectious Diseases (CANMOD), they're studying how diseases spread and helping to anticipate the future course of an outbreak and, through the COVID-19 Evidence Network (COVID-END) hosted at McMaster, they're rapidly synthesizing the best available evidence about key COVID-19 topics to ensure decision-makers have timely access to the best science. They're evaluating the torrent of studies and reports to determine if the use of a specific drug or intervention (hydroxychloroquine, for instance) is backed by scientific evidence – critical information to guide decision-making and policies at all levels of government. And researchers in the Canadian Research Data Centre Network, a consortium of universities and Statistics Canada headquartered at McMaster, are helping to drive policy change in areas like education, while research from the Canadian Longitudinal Study on Aging, a landmark national project based at McMaster, is providing insight into how the pandemic has affected older Canadians.

McMaster is one of just a few academic institutions in Canada with the capability of manufacturing vaccines for human trials, with researchers also developing new methods for delivering vaccines that advance the science in this field. McMaster researchers already have two vaccine projects that use this technology: one for tuberculosis, which is already in phase II clinical trials, and a next-generation coronavirus vaccine that is moving forward through the pipeline.

"We started the Global Nexus initiative to bring together great biomedical researchers, engineers, evidence experts, sociologists and humanists to rapidly solve big problems on a global scale, supported by the right infrastructure," says Dr. Wright. "By doing this, we're now better prepared to fight future pandemics and biological threats that we will inevitably face."



Virologist Karen Mossman, McMaster's vice-president of research, believes a collaborative approach is essential for achieving tangible impact. **SUPPLIED**



Gerry Wright, infectious disease expert and lead of Canada's Global Nexus for Pandemics and Biological Threats, credits CFI funding for helping to attract top talent to the team. **SUPPLIED**