

# No time for complacency: The CoVaRR-Net Biobank is an essential element of laboratory preparedness for infectious disease outbreaks

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## ABSTRACT

The SARS-CoV-2 pandemic highlighted the need for rapid, collaborative, and population-centric research to define health impact, develop health care policies and establish reliable diagnostic and surveillance tests. Critical for these objectives were in-depth clinical data collected in standardized fashion and large numbers of various types of human samples prior and post-viral encounter. As the pandemic evolved with the emergence of new variants of concern (VOCs), access to samples and data from infected and vaccinated individuals were needed to monitor immune durability, the possibility of increased transmissibility and virulence, and vaccine protection against new and emerging VOCs. Therefore, essential to the pandemic response is a strong laboratory and data research component, supported by effective biobanking and data sharing. Critically important to the speed of the research response is the rapid access to biobanked samples. To address critical challenges brought to light by the pandemic, the Coronavirus Variants Rapid Response Network (CoVaRR-Net), funded by the Canadian Institutes of Health Research, was established to coordinate research efforts to provide rapid evidence-based responses to emerging VOCs. The purpose of this paper is to introduce the CoVaRR-Net Biobank and define its contribution to pandemic preparedness.

**KEYWORDS:** biobank, pandemic, preparedness, SARS, severe acute respiratory syndrome, variants of concern

## RÉSUMÉ

La pandémie de SRAS-CoV-2 a fait ressortir la nécessité de réaliser des recherches rapides, coopératives et populationnelles pour en définir les effets sur la santé, promulguer des politiques sanitaires et établir des tests diagnostiques et des tests de surveillance fiables. Pour réaliser ces objectifs, il était essentiel de colliger des données cliniques approfondies d'une manière standardisée et d'amasser un grand nombre de divers types d'échantillons humains avant et après le contact viral. Lorsque la pandémie a évolué par l'émergence de nouveaux variants préoccupants (VOC), il est devenu nécessaire d'accéder à des échantillons et à des données de personnes infectées et vaccinées pour surveiller la durabilité de l'immunité, la possibilité d'une transmissibilité et d'une virulence accrues et la protection conférée par les vaccins contre les VOC nouveaux et émergents. Ainsi, il est essentiel de disposer d'un vigoureux volet de recherches de laboratoire et de recherches à partir de données pour répondre à la pandémie, soutenu par une mise en biobanque et un partage des données efficaces. Pour assurer une réponse rapide par la recherche, il est tout aussi important d'accéder rapidement aux échantillons mis en biobanque. Afin de relever les défis cruciaux soulevés par la pandémie, le *Coronavirus Variants Rapid Response Network* (réseau de réponse rapide aux variants du coronavirus; CoVaRR-Net), financé par les Instituts de recherche en santé du Canada, a été créé pour coordonner les efforts de recherche afin de fournir des réponses rapides fondées sur des données probantes aux VOC en émergence. Le présent article vise à présenter la Biobanque CoVaRR-Net et à en définir la contribution à la préparation aux pandémies.

**MOS-CLÉS:** biobanque, pandémie, préparation, SRAS, syndrome respiratoire aigu sévère, variants préoccupants

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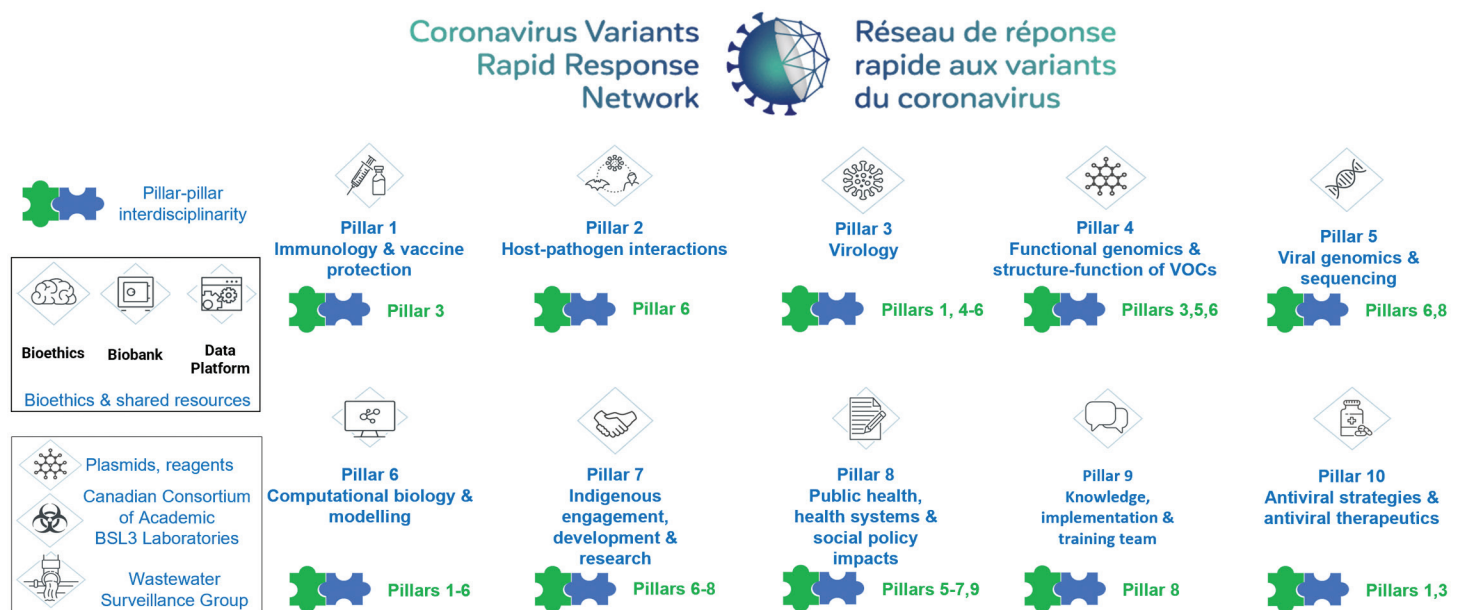
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## OVERVIEW OF CORONAVIRUS VARIANT RAPID RESPONSE NETWORK (CoVaRR-Net)

To address challenges posed by variants of concern (VOCs) in Canada, the Coronavirus Variants Rapid Response Network (CoVaRR-Net), funded by the Canadian Institutes of Health Research, CIHR (<https://covarrnet.ca>), was established to coordinate research efforts to provide rapid evidence-based responses to the ongoing threat of SARS-CoV-2, its VOCs, and the implication of their transmission in our population. The network engages in rapid pandemic research, accelerates diagnostic and surveillance assay development, and communicates research findings and advice to decision makers in Canadian health policy in relation to

the risk posed by emerging pathogens to existing drug therapies, vaccine effectiveness, and public health. CoVaRR-Net is a national network of researchers operating through a framework consisting of 10 complementary and interdisciplinary pillars in basic, applied, and clinical science, epidemiology, public health, and knowledge mobilization across which many researchers are collaborating (Figure 1). Membership to the network is considered upon request or invitation. Embedded within the network is a mandate to promote equity, diversity, inclusion, and Indigeneity in its research. Critical to the network's operations of knowledge exchange and strong laboratory research, is a Biobank and Data Management Platform (DMP) designed for the rapid sharing of samples and data. These are governed by a



**Figure 1:** The CoVaRR-Net Biobank is central to the research operations of CoVaRR-Net

*Notes: CoVaRR-Net brings together Canadian researchers and experts in a variety of disciplines linked to emerging variants; connecting leading research laboratories related to the study of variants of concern, this network ensures a rapid and coordinated response to a complex pandemic; CoVaRR-Net is structured with ten themes or 'Pillars,' seven assessing a different biological aspect of variants, and three focused on Indigenous communities, public health impacts, and ensuring findings are quickly and efficiently communicated to decision-makers, scientists, and the general public; there are significant pillar-pillar interdisciplinary collaborations across this framework (indicated by the green and blue puzzle pieces); the Biobank and Data Platform are interacting with most pillars and captures other data and resources in the network (eg, research reagent listings, the Canadian Consortium of Academic Biosafety Level 3 (BSL3) Laboratories (CCABL3), and the Wastewater Surveillance Group); for more details, refer to [www.covarrnet.ca](http://www.covarrnet.ca)*

universal data and biological materials transfer agreement (UDBMTA) signed by all member institutions. The CoVaRR-Net Biobank and data platform model is operational and designed to grow, adapt, and innovate to respond to the imminent threat of the emergence of identified potential pandemic pathogens (PPP) and in particular, to enable the development of early diagnostic and surveillance assays (1). Thus, CoVaRR-Net is evolving from being a network forged in a reactive crucible of response to an ongoing COVID-19 pandemic to a network prepared for the next pandemic or mass infectious diseases emergency.

## PRE-PANDEMIC BIOBANKING AND PANDEMIC BIOBANKING

Biorepositories are critically essential research resources for biomedical research, yet most do not operate in a national network but as independent entities. Importantly, many of these biorepositories were created to host samples for the study of specific diseases, projects, and participant cohorts. As such, they may prioritize the release of samples for specific disease-specific research and are not designed to support the rapid needs of an emerging epidemic or pandemic.

At the outset of the pandemic, existing biobanks were not structured to address the emerging needs of a highly transmissible virus that rapidly spread globally. There were no facilities that were oriented to recruit both in-patient and outpatient cohorts. Rapid, coordinated research and connectedness between researchers and public health was not established. Sharing of samples and research results was limited. In response, sites across Canada have developed local and provincial biobanking for the study of COVID-19, supported by provincial and federal seed funding: the Biobanque québécoise de la COVID-19 (BQC19, [www.bqc19.ca](http://www.bqc19.ca)) in Quebec funded by the Fonds de recherche du Québec—Santé/ Ministère de la Santé et des Services Sociaux/Public Health Agency of Canada (PHAC) (2); The University of Toronto COVID-19 Biobank (<https://temertymedicine.utoronto.ca/news/u-t-researchers-receive-15-million-cfi-funding-launch-unified-covid-19-biobank>), funded by the Canadian Foundation for Innovation Exceptional Opportunities Fund is mandated to support its affiliated institutions; the University Health Network Biobank supporting COVID-19 biobanking by its partner institutions (<https://www.uhnresearch.ca/news/covid-19-ice>); the British Columbia Biobank (BCBN) supporting British Columbia's COVID-19 biobanking efforts (<https://rci.med.ubc.ca/bc-covid-19-biobank-network/>); Alberta Precision Laboratories connecting Calgary and Edmonton research centres (<https://www.ualberta.ca/folio/2020/06/>

[unique-biorepository-stores-samples-from-alberta-covid-19-patients-for-future-research.html](https://www.ualberta.ca/folio/2020/06/unique-biorepository-stores-samples-from-alberta-covid-19-patients-for-future-research.html)); and remaining provinces/territories COVID-19 biobanks are housed in individuals investigator laboratories. However, there was no framework to connect these resources across the country to enhance Canada's scientific research capacity in pandemic research by promoting research collaborations through the rapid sharing of materials and data to accelerate scientific discoveries that would ultimately translate into benefiting the health of Canadians.

## THE CoVaRR-Net BIOBANK AND DATA MANAGEMENT PLATFORM

The CoVaRR-Net Biobank exists as a decentralized model for participant recruitment with longitudinal, comprehensive clinical data collection, specimen collection for pathogen studies, biological sample collection for host responses/immunological studies, study design, standardized operating protocols for diverse sample processing, and reagent and microbial cataloguing. All of these components are supported by quality-control evaluations on samples and protocol variations in keeping with standards of practice in the field, for example, International Society for Biological and Environmental Repositories (ISBER). While the Biobank's headquarters are located at the University of Ottawa and The Ottawa Hospital Research Institute, it represents a nation-wide network of well-established biobanks and smaller project hubs across the country, all connected through a network Universal Data and Biological Material Transfer Agreement. This Biobank is unique in Canada with its highly differentiated surge capacity that supports academic researchers to quickly and effectively share resources and relay, in real-time, data, information, and recommendations to public health and work together with social policy pillars to formulate an action plan to benefit the health of the public.

Among the unique features of the CoVaRR-NET Biobank, afforded by networking its biobank partners, are the longitudinal collection of comprehensive clinical data, which enables researchers to evaluate the disease (including laboratory diagnostic markers and the effect of any intervention) over time. The biological specimens collected enable the in-depth and dynamic study of both pathogen (eg, nasopharyngeal samples) and host response in specific subgroups (eg, actively infected with SARS-CoV-2, convalescents, vaccinated individuals, unexposed individuals). The Biobank also brokers the sharing of research reagents through a plasmid collection database (Lunenfeld Centre, Toronto, ON, Canada) and pathogens for research via The Canadian Consortium of Academic Biosafety Level

3 Laboratories (CCABL3) founded by CoVaRR-Net. In addition, as the DMP is involved in the datafication of CoVaRR-Net's Wastewater Surveillance study (3), the Biobank is mobilizing to offer storage solutions for this Canadian-born research resource.

## A CANADIAN-MADE BIOBANK

The Biobank is designed to be inclusive, ethnically diverse, and geographically distributed across Canada, in keeping with its foundation of equity, diversity, inclusion, and Indigeneity. A governance structure akin to a population-based biobank has oversight provided by a committee consisting of a biobank Director, a DMP Director, research ethics experts, members across the network pillars, as well as patient and Indigenous monitors, operating with transparency as a key component of its process. Ethical approval has been granted through Clinical Trials Ontario (CTO ID: 3763), which provides multi-jurisdictional research ethics oversight for qualifying organizations. Similar approvals at equivalent ethical organizations will be sought in other provinces as well as from organizations that do not participate in multi-jurisdictional programs to increase inclusivity. Critical to the mission of CoVaRR-NET and the Biobank is Indigenous partnerships and inclusion into potentially life-saving research. To this end, ethical approval for First Nations participation is being sought with the assistance of CoVaRR-Net Pillar 7: Indigenous Engagement, Development, and Research. Finally, as custodians of this resource, the Biobank strictly follows Ownership Control Access and Possession (OCAP) principles that are defined by the First Nations Information and Governance Centre (FNIGC). These principles also guide the standard operating procedures for the processing, transport, storage, and accession of Indigenous samples by the central facility. The FNIGC is actively seeking support from a CIHR First Nations Biobanking and Genomic Research funding opportunity and CoVaRR-Net was invited to be a *Knowledge User* in this effort. In fact, the CoVaRR-Net model ensures that all partner biobanks retain autonomy of governance over data and sample distribution entrusted in their care, including the acknowledgment of OCAP principles. Lastly, all information pertaining to biological specimens and participants data linking biobanks shared through CoVaRR-Net is de-identified and prioritizes the preservation of privacy in accordance with provincial requirements.

## OVERVIEW OF BIOBANK CONTENT

The Biobank currently supports seven studies consisting of 1,800 participants, 19,811 samples collected, and 58,631 aliquots stored with specimens derived from relevant

sub-groups, including those actively infected with SARS-CoV-2, convalescents, vaccinated individuals, unexposed individuals and individuals with hybrid immunity. Approximately 12,206 sample aliquots have been distributed between network members and 11 projects are supported as of May 2022 (Table 1). The inventory includes samples flagged by VOC identity, including the Omicron variant. The Biobank has developed a partnership with BQC19, which complements the existing inventory. Other partnerships are being developed across Canada. These partners are also connected through our DMP, which is supported by a custom application programming interface (API) between the information management systems of each individual partner and the central biobank and where data are harmonized to a common data model. This allows for the establishment of a central biobank catalogue that enables querying across biobanks at the sample level and where researchers and public health laboratories can access information on the included studies (eg, study design and data collection status, number of participants, type of biological material and availability of samples and sample aliquots). Similar networks of biobanks established in the European Union (EU) have supported several multi-site national and international research projects and empowered researchers in the EU to conduct timely scientific research throughout the pandemic (4,5). Similarly, the CoVaRR-Net Biobank continues to build capacity as a national resource and facilitator of rapid sample distribution and data sharing for COVID-19 research across the network.

## LESSONS OF THE PAST POINT TO THE NEED FOR RESEARCH PREPAREDNESS

While the CoVaRR-Net Biobank was established in response to the COVID-19 pandemic, it fills a gap in Canada's infrastructure for emerging infectious disease preparedness. Previous microbial threats to Canada have been classified as either limited (eg, SARS in 2003), potential (eg, Ebola in 2014, monkeypox) or contained (pandemic influenza in 2009). However, these threats clearly signalled a call for action, which had not been prioritized until COVID-19 (6,7). Rapid identification, sentinel surveillance and early advances in virology were credited with limiting the impact of the 1957 Asian and 1968 Hong Kong influenza pandemics (6). Of note, these previous outbreaks have been marked by the collection and storage of the respective pathogen, but a near absence of any human biological samples of infected individuals. This gap paralyzes the capacity to analyze human immune responses to these pathogens, resulting in a 'start from scratch' strategy for re-emerging infections. Although they are commonly sudden in onset and appear

**Table 1: CoVaRR-Net Biobank catalogue**

		Total	Partner biobank						
Site	Ottawa CV-McG	Ottawa LEFT	Ottawa SSO	Ottawa FUSION	Ottawa VISID	Ottawa VIP	Toronto CV-Gom*	7	BQC19
Theme	Hospitalization	Long-COVID	Surveillance	Case registry	Immunodeficiency	Cancer	Surveillance	Broad	Broad
Study status	Complete	Complete	In progress	In progress	In progress	In progress	In progress	In progress	In progress
Participant registration (closed/target #)	Closed	Closed	Closed	Open	Open	?	150	Open	Open
Participants	65	70	1,181	500	56	199	133	2,204	5,587
7 studies	137	210	2,791	-	211	76	197	3,622	8,821
	626	958	14,005	-	671	130	2,920	19,310	28,760
	234	91	72	-	174	-	274	845	278
	1	1	1	-	1	-	3	7	2
2,204 participants	325	210	2,660	500	209	69	219	4,192	10,855
	1,393	1,053	16,016	3,000	796	264	3,719	26,241	23,700
	348	84	1,410	-	167	-	1,501	3,510	10,757
	1	1	2	-	1	-	7	12	3
22,101 samples	520	210	4,609	-	180	69	-	5,588	6,264
	5,200	792	11,387	-	475	460	-	18,314	218
	172	268	4,307	-	1	-	-	4,748	1,550
	1	2	1	-	1	-	-	5	2

(Continued)

**Table 1:** Continued

Site	Study name	Ottawa	Ottawa	Ottawa	Ottawa	Ottawa	Ottawa	Ottawa	Ottawa	Toronto	Total	Partner biobank
		CV-McG	LEFT	SSO	FUSION	VISID	VIP	CV-Gom*	BQC19			
73,592 aliquots	Samples of dry blood spot	36	142	7,358	-	-	496	30	8,062	5,430 <sup>†</sup>	7	BQC19
	Samples of whole blood on ACD	-	-	-	-	-	-	-	-	4,358	-	-
	Distributed samples	18	90	3,394	-	-	-	24	3,526	123	-	-
	Number of projects that have accessed DBS	1	1	1	-	-	-	1	4	2	-	-
12,801 distributed	Samples in salivette container	-	-	396	-	-	-	241	637	-	-	-
	Aliquots of 0.5 mL	-	-	997	-	-	-	668	1,665	-	-	-
	Distributed aliquots	-	-	-	-	-	-	172	172	-	-	-
	Number of projects that have accessed saliva	-	-	-	-	-	-	1	1	-	-	-
13 projects supported	Associated analytical data	-	-	-	-	-	-	-	-	-	-	-
	Visits with serology	190	194	4,609	-	168	144	186	5,491	-	-	-
	Visits with SARS-CoV-2 saliva-based PCR test	-	-	6,008	-	-	-	-	-	-	-	32,868
	Visits with immune cell phenotyping	137	Pending	Pending	-	174	Pending	Pending	311	-	-	-

\*Last available detailed update: October 2022

†Only DNA extract shared

ACD = Acid citrate dextrose; BQC19 = Quebec COVID-19 Biobank; CV-Gom = COVID-19 Gommerman study; CV-McG = COVID-19 McGuinity study; DBS = Dried blood spot; FUSION = Plasma only, The Ottawa Hospital; LEFT = Long-term Effect of SARS-CoV-2 Infection on Physio- and Psychological Health; PBMC = Peripheral blood mononuclear cell; PCR = Polymerase chain reaction; SSO = Stop the Spread Ottawa; SARS-CoV-2 = Severe acute respiratory syndrome coronavirus 2; VIP = Vaccine Immunity in Populations with Immunological Cancers; VISID = Vaccine Immunodeficiency and Safety in Immunodeficient Patients

unpredictable in nature, infectious disease outbreaks occur with regularity. Influenza and other high-threat viral pathogens such as Ebola and dengue viruses have been listed by the World Health Organization (WHO) as major threats to public health and count among the PPP and a targeted research area defined by the US Government and the Department of Health and Human Services (1). It is estimated that 60% of known pathogens that are infectious to humans arise through transmission between animals and humans (8), while 17% of human infections are vector-borne (9). Such infections pose a very real threat of death, as is evidenced by the mortality associated with SARS-CoV-2 (10%), Nipah virus (40%–75%) and Ebola virus (88%). Other infections may be associated with long-term sequelae, such as West Nile neuroinvasive disease or Zika virus and fetal malformations. The CoVaRR-Net Biobank aims to retain and utilize the momentum achieved in this current pandemic to maintain and develop capacity to respond, as a network, to future pandemics and outbreaks.

Complacency and lack of preparation has led to life-threatening delays in the response to the SARS-CoV-2 pandemic regarding available treatments, population-wide pathogen detection, infection control measures in health care facilities, public health measures in communities, and vaccine availability. This has been identified in a recent independent report by the Office of the Auditor General to the Parliament of Canada. That report mentions several mechanisms to better maintain, update, and improve upon the readiness of the Public Health Agency of Canada to respond to an emerging pathogen and urges the agency in several recommendations to work with its partners to establish an effective, maintained, and adaptable preparedness plan on the academic front (10). A plan for future preparedness should include CoVaRR-Net and the CoVaRR-Net Biobank and DMP. The initial response to the SARS-CoV-2 pandemic resembled, in part, that of previous large-scale outbreaks of recent memory (7). When SARS-CoV-1 and MERS-CoV were successfully contained through implemented public health measures, the interventions were subsequently not maintained or expanded, despite robust debriefing by a wide variety of stakeholders and further development of pharmaceuticals effective against the coronavirus family of viruses were suspended and scientific funding support was withdrawn. Consequently, without a developed Canadian preparedness plan, a rapid, coordinated, and scientifically informed response was critically needed. Furthermore, a reliance on foreign entities for information, research and development, pharmaceutical products, personal protective equipment, and guidance on domestic policy contributed to the vulnerability of Canadians to SARS-CoV-2. The rapidity of sampling and sharing of resources and data

afforded by the CoVaRR-Net Biobank and DMP will be an important element of Canada's pandemic preparedness plan to improve response speed and outcomes in future public health crises. This complements the ongoing evolution of CoVaRR-Net research capacity alongside public health systems in the face of a dynamic threat and in preparation for future such challenges.

In addition to these obstacles that impaired the Canadian scientific and medical community to respond to the pandemic, there was also a scarcity of data that reflects the Canadian demography. There is a need for a Canadian biobank that represents the ethnic diversity and age pyramid of Canada. This cannot be met by biobanks in other countries. Our reliance on foreign information, such as data from Israel, the United Kingdom, the United States (CDC), and China, resulted in a struggle to translate into the realities of the Canadian landscape. This has been highlighted by differences in national public health policies. For example, the introduction of mix and match (heterologous) vaccines and longer intervals between doses proved to be a successful approach for Canada (11,12), but for which data from other countries would have been misleading. To anticipate, understand and appropriately respond to emerging pathogens, Canadian-specific data are required. This includes the collection of sensitive data such as gender, ethnicity, comorbidities, and so forth, which constitute important information that must be captured to understand who is most vulnerable in our own population in a pandemic and how resources could be deployed to mitigate transmission. Certain ethnic populations in Canada have COVID-19 seroprevalence high above the community average (eg, South Asians in the Greater Toronto Area, COVID CommUNITY South Asian Research Team, unpublished; and Filipinos in Manitoba [13]). As well, viral community transmission rates have been extremely high in some Indigenous communities, captured indirectly by provincial COVID-19 dashboards (eg, Northern Ontario tracked by the Science Table for the COVID-19 Advisory for Ontario [14]) but, overall, insufficiently documented across Canada (15). Thus, to determine reasons for such vulnerability (genetic, socio-economic, or otherwise), biobank samples must contain disaggregated, personal health information on a national level. Beyond our own domestic benefit and based on lessons learned during the pandemic, Canada can assume a leading role globally in epidemic preparedness and response.

### CoVaRR-Net PLANS FOR PANDEMIC PREPAREDNESS IN ACADEMIC RESEARCH

Infectious disease preparedness requires organized structures, leadership, and sustained funding. This must include laboratory and data support that transcends the individual

institutions where the research is conducted. This pandemic has clearly showcased the capacity of academic laboratories as a driving force to the pandemic response and a primary source of rapid response studies and data to support public health decisions. CoVaRR-Net is ideally positioned to continue in this role. It is incumbent on Canada to invest in pandemic preparedness through the permanent support of biobanking initiatives such as the CoVaRR-Net Biobank. Biobanks are vital because they enable microbial surveillance. Equally important are their collections that facilitate scientists in academic and government laboratories to collaborate and complement one another to be prepared for the next pandemic. The requirements for effective and rapid biobanking discussed here far exceed the capacity of the Canadian public health network. By design, the CoVaRR-Net Biobank and DMP are meant to be a complement to Canadian public health laboratories and the National Microbiology Laboratories (NML): a relationship that continues to require time to be established robustly. The Biobank's vision includes planning for 'surge capacity' in laboratories with sufficient biological safety containment and other biosecurity equipment to address dangerous pathogens in collaboration with the NML. This should entail framework protocols and pre-existent contractual relationships among key stakeholders to promote immediacy of scientific response, while minimizing administrative delays. Preparedness will require having the people, data and tools in place that are actively being engaged such that when a pathogen emerges, including of pandemic proportions, there is agility and rapidity in our response, thereby mitigating the impact of the novel organism on Canadian society. CoVaRR-Net initiated the Canadian Consortium of BSL3 (CCABL3) Laboratories to support the laboratory component of working with, cataloguing, and storing risk group 3 samples. This consortium of BSL3 labs, can identify for CoVaRR-Net Canadian academic researchers with the appropriate certifications and expertise to intake patient samples (facilitated in part by established CoVaRR-Net research ethics protocols and contracts) and isolate pathogens for rapid characterization. With ongoing sampling and surveillance systems in place, the Biobank can simplify historical queries on emerging pathogen prevalence and support monitoring of endemic pathogens like seasonal influenza. As stated earlier, rapid access to samples, pre-pandemic and otherwise, is critical for test development, including sensitivity and specificity and assessment of cross-reactivity to existing microbial threats when confronted with an epidemic/pandemic to avoid flawed serosurvey information.

CoVaRR-Net and its Biobank are highly suited to respond to a SARS-CoV-2 variants as they emerge,

capturing the impact on vaccines approved and deployed in Canada. The long-term vision for the CoVaRR-Net Biobank is to strengthen the network by expanding the reach of national sampling, surveillance, and analysis as it aims to evolve into a Pandemic Preparedness Network, linked with public health laboratories, academia, and industry for the concerted effort that is critical during any microbial threat. Continuing financial support is essential, not only to retain valuable pandemic specimens and data platforms, but to establish and maintain dedicated infrastructure and highly qualified personnel to support future preparedness. This would be a complement to the recent proposal for the continued funding of the Canadian Immunization Services, which emphasizes the need for a pan-Canadian coordination of efforts to unify siloed responsibilities/responses by addressing the challenges to consistent immunization practices and the sharing of data across the country (16). The concept of a Learning Healthcare System (LHS) (17,18) is gaining recognition as a mechanism that links public health with health care systems to facilitate the sharing of data, research, incentives, and practice to improve health. The theoretical framework for LHS does not include public health yet. More recently, a role for public health in a LHS has been proposed (19), which, in the context of the COVID-19 pandemic, should be considered. There is an opportunity to propose a model for a public health learning health care system (LHS) based on existing samples and data that can be expanded upon with the growth of the Biobank. With the advent of the COVID-19 pandemic, a multi-faceted blueprint for national pandemic preparedness is being planned for Canada and will feature surveillance, biobanking, and data sharing. CoVaRR-Net is well positioned to lead in the academic efforts for pandemic preparedness. In particular, CoVaRR-Net has an opportunity to innovate and lead in the development of a learning public health system (LPHS), building on the LHS concept mentioned earlier. The CoVaRR-Net Biobank is uniquely positioned to develop a model based on existing samples and data across its networked sites and is designed to grow as the biobank expands. Specifically, integrating the CoVaRR-Net Biobank and database with laboratory research and preparedness in a framework of established contracts, approved ethics protocols and standard operating procedure would facilitate timely responses to public health emergencies to yield research success for social good. In addressing more common outbreaks on a regular basis through this established framework, it will not only benefit our response to lingering pathogens, but also serve as a rehearsal for the next threat of pandemic proportions.



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**INFORMED CONSENT:** N/A

**REGISTRY AND THE REGISTRATION NO. OF THE STUDY/TRIAL:** N/A

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