CANADIAN LYME DISEASE
RESEARCH NETWORK

A YEAR IN REVIEW

301 Members

35 Patient Partners

18 CLyDRN Webinars

38 Publications

2 Books & Book Chapters

5 Reports & Technical Reports

2 Guidelines

46 Presentations

45 Interviews

74 Students & Trainees

$1.18M New Funding

324 Stakeholders involved in various stages of Research Process

Featured in this Review:

Message from the Director

The past three years have challenged us in ways we could not imagine. They have made us adapt to new realities during a global pandemic and inspired us to never give up during our journey to improve the evaluation, prevention, diagnosis, and treatment of Lyme disease in Canada. But most importantly, this challenging period has shown us that when we work together, we can overcome tremendous challenges and adapt quickly to support our commitment to excellence in research and education. We stand united as patients, family caregivers, scientists, community partners, and other stakeholders, and we are more committed than ever to our vision.

Although the pandemic caused significant disruption for research and innovation, with every challenge comes opportunities. The Network created mitigation strategies and re-designed and modified projects which have allowed research activities previously side railed to reinitiate momentum to get us back on track. We are proud of our accomplishments to date, some of which are highlighted below:

1) The Lyme Disease Awareness events held in May 2022 and at the Annual General Meeting (AGM) held in November 2021 were very successful, to host presentations virtually from stakeholders across the country including researchers, students, trainees, patients, family caregivers, community members, and Lyme advocates who all volunteered time to participate.

2) The adaptability of the Network members to find ways to continue to work collaboratively throughout the pandemic has been truly inspiring. This past year has seen restructuring and renewed engagement around Pillar and Committee working groups, with the emergence of broadened vision and scientific focus to consider the other tick-borne diseases presenting new challenges across the Canadian landscape.

3) Launching most of the Pillar research projects originally envisioned by the spring/summer 2022, including the recruitment of participants for our clinical studies at the Kingston, Ontario and Lunenburg, Nova Scotia sites.

4) Focusing our efforts on finding ways to help translate priorities identified from our patients, family caregivers, and community stakeholders through engagement and collaboration into fundable new research grants.

As we approach the end of our Canadian Institutes of Health Research (CIHR) grant that has allowed us to establish the Network, we look forward an exciting year ahead, focused on turning the visioning and strategic planning initiated over the past months into new funding opportunities, propelling the Network to new heights in the years to come and position it to address the broader challenges of climate-driven emergence of a broad range of tick-borne diseases.

Looking forward, we hope you join us for our virtual CLyDRN Members 2022 AGM that will be occurring in the fall 2022, where our Pillars and Committees will provide an update on their activities over the past year, our students and trainees will have oral and poster presentations, we will have guest speakers for our plenary session and panel discussion, and there will be many opportunities for networking. A year-in-review in the following pages provide a snapshot of CLyDRN's research and training activities over the past year that will be presented at our AGM.

We cannot thank you enough for your ongoing support of our Network and look forward to welcoming you at our virtual and in-person events in the coming year.

Patrick Leighton, BSc, PhD
Associate Professor, Epidemiology & Public Health, Faculty of Veterinary Medicine, Université de Montréal
Director, Canadian Lyme Disease Research Network

Pillar and Committee Updates

Pillar 1 (Diagnostics)
(CO-LEADS: Twylla Bird-Gayson, Tara Moriarty, Muhammad Morshed, & Terrie Wainwright)

Through an extensive priority setting process carried out between 2019-2021, the Patient and Community Advisory Committee (PCAC) identified and prioritized research gaps related to Lyme disease diagnostic testing and came up with their top patient priorities: (1) current Lyme disease diagnostic testing is unreliable; (2) current testing modalities lack adequate sensitivity and specificity to accurately diagnosis Lyme disease; and (3) two-tiered serological testing yields inconsistent results among patients that share similar tick exposure histories, clinical portraits (bloodwork not related to Lyme disease, symptoms, level of functioning), and who previously had erythema migrans. Improving sensitivity and specificity of diagnostic tests is inherently embedded in the patient priorities when it comes to improving diagnostic policies and current clinical guidelines and practices that in turn may improve patient clinical pathways and health outcomes.

A consultant was hired in May 2021 to work with the Pillar 1 patient partners and scientists to help develop the research goals, study design and methodology, budget, final protocol, and to assist with creating applications to submit to the respective research ethics boards. The consultant has been leading the discussions between the Pillar 1 scientific leads and patient and family partners over the last year to: (1) identify and determine consensus on the ultimate research goals based on the priorities identified by the patient partners; (2) ensure the project was both feasible and meaningful for all concerned on the team; (3) ensure the project was completed within the timelines of the original CIHR grant; (4) work with available resources and capacity of the Network scientists during and post pandemic; and (5) work within known constraints, including: (i) not having immediate access to the Pillar 3 biobank samples (still under development); (ii) not being able to characterize and validate Lyme disease illness across the full spectrum of stages and conditions (early, disseminated, and chronic; limited to early-stage only); (iii) not being able to validate all commercially available diagnostic products used globally for Lyme disease, tick-borne diseases, and other co-infections due to the quantity of available serum samples; (iv) not being able to integrate with other pillar projects and make use of existing research infrastructure and support as other projects had already been rolled out

and/or completed before the Pillar 1 project protocol was developed; and (v) not be able to align with all expected research priorities identified by patient partners. Research priorities not covered during this pilot project will be parked for use in future funding discussions for the Network.

The Pillar 1 members met on an ongoing basis to define the attainable research goals based on what could be done recognizing the limitations and constraints for the project. The consensus goals agreed upon by the Pillar 1 members were to: (1) measure and compare the accuracy (i.e., the ability of a diagnostic test to determine who does and does not have illness) of standard two-tiered testing (EIA (enzyme immunoassay) followed by IgM and/or IgG immunoblots) with that of modified two-tiered testing (two EIAs) in lower endemic areas (British Columbia and Ontario) using available stored patient serum; (2) determine the proportion of stored patient serum that also tests positive for an expanded list of domestic and European Borrelia species using commercially available laboratory tests authorized for sale and available for purchase in Canada (Health Canada approved) but not generally covered by standard provincial testing; and (3) report all patient and community involvement and contributions using the *Guidance for Reporting Involvement of Patients and the Public* (GRIPP2-SF) checklist. The overall objective of the pilot study is to determine if modified two-tiered testing (MTTT) can detect increased numbers of early Lyme disease cases in areas with low Lyme incidence and to determine to what extent patients who are being tested for Lyme have any evidence of having been exposed to other Borrelia species beyond that which is routinely offered. While the results of this study will not specifically impact Lyme disease diagnostic standard practices, it may provide evidence that could point to ways that may improve upon current standard practice and clinical guidelines.

The research goals were then presented to the PCAC members in January 2022 and the research goals received majority endorsement to move forward to develop the draft protocol. Pillar 1 members are currently working on refining the draft protocol which will be shared with the PCAC members by August 2022 (target date), with a presentation to PCAC members in September 2022 (target date) for soliciting input and endorsement from PCAC members to move forward with creating the final protocol that incorporates their feedback. Following majority endorsement from PCAC members of the final protocol, the protocol will be submitted and presented to Network Leads and CLyDRN Executive Committee in October 2022 (target date) for soliciting additional input, feedback, and endorsement. The last step will be to submit the final protocol and attendant documents to the respective research ethics boards (REBs) for obtaining ethical clearance to commence the project. Pillar 1 members are aiming to submit the application

packages to the respective REBs by late fall 2022/early winter 2023. Once ethics clearance has been obtained, it is envisioned that sample collection and analysis will occur throughout 2023, starting in the spring 2023, with data analysis occurring in 2024.

Since the original research goals were presented to PCAC members in January 2022, the protocol has now been revised, in consultation with the provincial lab scientists, to include prospective serum samples collected from new patients (first tick bite/exposure) who are being serologically tested for Lyme disease during the 2023 Lyme disease season from the provincial labs in British Columbia (British Columbia Centre for Disease Control Public Health Laboratory) and Ontario (Public Health Ontario Laboratory in Toronto). Stored samples previously collected in the provincial labs (2022 and earlier) will no longer be analyzed. To minimize inter-laboratory variation all study samples will be analysed in the British Columbia laboratory.

Pillar 2 (Prevention & Risk Reduction)
(CO-LEADS: Catherine Bouchard, Manisha Kulkarni & Pamela Scott-Crace)

Pillar 2 aims to assess, track, and predict the changing risk of Lyme Disease in Canada to identify and inform targets for risk reduction through three project initiatives:

- **Canadian Lyme Sentinel Network (CaLSeN)**: The Canadian Lyme Sentinel Network is a pan-Canadian network of sentinel regions providing the necessary data to support studies aimed at understanding and predicting Lyme disease risk for Canadians from coast to coast.

- **Longitudinal Risk Study**: The Longitudinal Risk Study is a multi-site longitudinal study built on the sentinel network structure, making it possible to assess the effects of environmental, social, and individual determinants on emerging Lyme disease risk across Canada.

- **Risk Reduction Innovation Program**:   The Risk Reduction Innovation Program uses seed funding to stimulate innovative research into new ways to measure, map and reduce Lyme disease risk in Canada. Research directions are developed by two dedicated think tanks (interdisciplinary working groups) bringing together researchers, patients, and stakeholders from a diversity of sectors across Canada, with proposals reviewed at the network level.

Four working groups were established to oversee the three Pillar 2 project initiatives: Surveillance, Epidemiology, Intervention, and Modelling. Pillar 2 presented an update on all Pillar 2 working group activities at the CLyDRN AGM in November 2021 and held a Pillar-wide meeting in May 2022 to provide further updates to Pillar 2 members. A summary of the objectives and progress of each working group follows:

Surveillance Working Group

The objective of the Surveillance Working Group is to develop a pan-Canadian network of sentinel regions where active tick surveillance is conducted on an annual basis to assess the status of *Ixodes scapularis* (*I. scapularis*) populations and the accompanying pathogens. Field surveillance data will be integrated with other surveillance data to provide a comprehensive picture of Lyme disease risk across these sentinel regions.

The network (CaLSeN) was established in 2019, with at least one sentinel region in each province. It has subsequently expanded and with additional funding from the Public Health Agency of Canada, we will be doubling our field surveillance effort from 2019 to include 200 sites across 36 sentinel regions in the 2022-23 field season (see list of sentinel regions below). Annual surveillance activities will be extended into 2023 to collect 3 consecutive years of data (2021, 2022, 2023).

Research Questions:

1) What is the current distribution of *Ixodes scapularis* and its pathogens across selected regions in Canada? How does this change over time?

2) What is the value of integrating veterinary tick and tick-borne disease data into the sentinel surveillance approach? How can this be done effectively and efficiently?

Expected outcomes:

We will generate a longitudinal dataset that illustrates the status of *I. scapularis* populations in regions across Canada, as well as the infection prevalence of pathogens of human and animal health concern within these populations, including *Borrelia burgdorferi* (*B. burgdorferi*). We will generate maps each year depicting the surveillance finding of each sentinel region. A shared dataset will be available to all collaborators.

2021-22 Activities:

In 2021-22, this group refined the multi-criteria decision analysis (MCDA) for selection of additional sentinel sites for expansion of CaLSeN and successfully resumed CaLSeN tick surveillance activities in spring/summer 2021 in collaboration with provincial and regional public health partners in all sentinel regions. Teams from Université de Montréal, University of Ottawa, University of Guelph, University of Manitoba, University of Saskatchewan, British Columbia Centre for Disease Control (BCCDC), and University of New Brunswick, who participated in the 2019 field season conducted field activities in June 2021. New surveillance partnerships in 2021 include the Centre for Coastal Health (British Columbia), University of Calgary (Alberta) and Acadia University (Nova Scotia). Adapted field research protocols piloted for COVID-19 mitigation in 2020 allowed us to proceed with field work while respecting government and university health and safety protocols.

In 2019 there was active tick surveillance in 96 sites across 14 sentinel regions. The 2019 results were published in the October 2020 Canadian Communicable Disease Report (https://doi.org/10.14745/ccdr.v46i10a08). Due to COVID-19, there was no tick surveillance carried out. In 2021 there was active tick surveillance in 115 sites across 17 sentinel regions. Laboratory testing of collected tick specimens during the spring/summer 2021 was completed in Sept-Dec 2021 and data have been compiled for results synthesis. The working group commenced monthly teleconferences in January 2021 to plan for the 2022 field season.

In 2021-22, we also launched a pilot study to examine the utility of integrating veterinary tick and tick-borne disease data into the sentinel network. Sixteen clinics across four sentinel regions in Ontario are part of this pilot project. The first phase was completed in October – November 2021 and the second phase will be completed in May – June 2022.

The sentinel regions of CaLSeN are as follows:

- British Columbia (BC): Victoria, Vancouver, North Vancouver Island, Okanagan
- Alberta (AB): Lethbridge, Red Deer, Calgary, Edmonton
- Saskatchewan (SK): Regina, Saskatoon, Yorkton/Russell* (three sites in SK), +/- Prince Albert
- Manitoba (MB): Winnipeg, Brandon, Yorkton/Russell* (two sites in MB)
- Ontario (ON): Sault Ste. Marie, Sudbury, Kingston, Ottawa-Gatineau, Peterborough, Muskoka, London, Guelph +/- Kenora
- Québec (QC): Montréal, Trois-Rivières, Sherbrooke, Québec, Saguenay, Rivière-du-Loup
- New Brunswick (NB): Fredericton, St. John
- Nova Scotia (NS): Digby, Lunenburg, Amherst
- Prince Edward Island (PEI): Charlottetown
- Newfoundland & Labrador (NFLD): St. John's, Corner Brook

The sentinel regions in Ontario which the veterinary sentinel surveillance pilot is being conducted are Guelph, Ottawa, Kingston, and Muskoka.

Epidemiology Working Group

In the Canadian context, many individual, environmental and socioeconomic risk factors for human Lyme disease infection are yet to be ascertained. To address this knowledge gap, this working group oversees the Longitudinal Risk Study, which is comprised of two activities: (1) retrospective case-control study, and (2) prospective case-control study. The objective of the Longitudinal Risk Study is to identify and estimate the significant determinants of Lyme disease risk, including the degree of risk associated with residential and community exposure to ticks, and to assess differences knowledge, attitudes, and practice (KAP) related to Lyme disease. We will also assess how Lyme disease risk, its determinants, and KAP differ between endemic sites in ON and NS.

The retrospective case control study is a matched case-control study focusing on southeastern Ontario, using Lyme disease patient data from provincial laboratory databases and uninfected population controls accrued from 2014-2018. The prospective case control study is being conducted in two sites (Kingston, ON and Lunenburg, NS), using cases from the Pillar 3 Cohort study and hospital-based controls.

2021-22 Activities:

In 2021-22, data analysis for the retrospective case-control study was completed and a draft manuscript was prepared for submission to a scientific journal. The manuscript, titled "*Rurality, socioeconomic status, and residence in environmental risk areas associated with increased Lyme disease incidence in Ontario, Canada: A case-control study*" found that living in an area with high environmental risk (high predicted tick occurrence) (odds ratio (OR)=2.4; 95% confidence intervals (CI)=2.2, 2.6), low walkability (OR=4.1; CI=3.2, 5.3) and transit scores (OR=2.9; CI=2.2, 3.8), high proportion of parks (OR=1.034; CI=1.031, 1.036), and increased length of trail networks (OR=1.020; CI=1.010, 1.027) were significant neighbourhood risk factors for Lyme disease as well as higher neighbourhood socioeconomic status (high neighbourhood income: OR=2.1; CI=1.8, 2.4; low material deprivation: OR=2.3; CI=1.9, 2.7; low ethnic concentration: OR=12.8; CI=10.7, 15.3). Using multivariable modelling to adjust for these neighbourhood and socioeconomic risk factors, we found that the odds of Lyme disease infection for individuals residing in environmental risk areas was highest for those living in public health units with <250,000 population (OR=2.3; CI=1.7, 3.0) compared to those living in public health units with >1,000,000 population (OR=1.4; CI=0.97, 2.0). This study shows that risk of human Lyme disease infection in Ontario, Canada is higher in less urbanized areas with higher socioeconomic indices and affirms that living in regions with higher occurrence of ticks in

the environment is linked to increased odds of tick-borne diseases. Preliminary results of this study were presented at the November 2021 AGM.

For the prospective case-control study, which has been delayed due to COVID-19 disruptions alongside the Pillar 3 COHORT study, the Epidemiology Working Group updated the study protocol to incorporate new questions as part of the CLyDRN-funded PhD student's project. In addition, the process for recruitment of matched controls for the case-control study was finalized. The study was launched at the Kingston (ON) and Lunenburg (NS) sites in the spring/summer 2022 alongside the Pillar 3 COHORT study patient recruitment. The study will collect information on KAP regarding Lyme disease and exposure to Lyme disease risk areas from 90 Lyme disease cases (i.e., the early localized Lyme disease and early disseminated Lyme disease cases recruited through the COHORT study) and 180 matched controls using a structured questionnaire. The expected outcomes of this study include better understanding of the risk factors for Lyme disease infection and improved understanding of KAP differences between those with Lyme disease and those without, that can be used by our public health partners to inform Lyme disease campaigns. Project outputs will include scientific publications and presentation(s) and a policy brief.

Intervention Working Group

This group has oversight of the "risk reduction interventions" component of the Risk Reduction Innovation Program, which aims to:

1) Identify the most promising research topics for reducing Lyme disease risk across Canada.

2) Engage in continuous scientific monitoring, knowledge sharing about the new intervention/mitigation strategies (from the working group to the CLyDRN) and facilitating their implementation in Canada.

3) Develop guidelines to evaluate tick and Lyme disease intervention/mitigation strategies including (1) the potential public health impact of the existing or novel approaches; and (2) obstacles and levers to the implementation of these interventions.

In 2021-22, the working group finalized a work plan to utilize seed funding for projects focusing on the prioritization and assessment of Lyme disease interventions

(i.e., systematic review, cost-utility modeling, and MCDA for rodent-targeted interventions), which was developed in consultation with the PCAC members and approved by the CLyDRN Executive Committee. The project activities started in Winter 2022. Current projects involve:

1) Reviewing and assessing available preventive interventions relevant to the Canadian context (Status: ongoing - expected ending: June 2023).

2) Modeling the cost-efficacy of various rodent-targeted interventions (Status: beginning in June 2022 - expected ending: June 2024).

3) Prioritizing rodent-targeted interventions through an updated Multicriteria decision analysis process based on stakeholder consultations (Status: beginning in August 2022 - expected ending: June 2024).

Three projects are in progress:

1) To perform a comprehensive assessment of the effectiveness of interventions which reduce human-tick encounters, prevent tick bites, and reduce the risk of Lyme Disease and evaluate the current state of knowledge on the economic cost, environmental impact, and social acceptability of these interventions (Study area: mainly North America and Europe - Data sources: literature).

2) Model the cost-efficacy of rodent-targeted interventions in a public health perspective under different epidemiological conditions (Study area: Southern Quebec and similar social-ecological contexts of South-Eastern Canada - Data sources: literature).

3) Develop a comprehensive evaluation framework for rodent-targeted interventions that takes into consideration the economic, environmental, social, and public health parameters of such interventions and prioritize these interventions through a Multicriteria decision analysis process including relevant stakeholders (Study area: Eastern Canada - Data sources: literature and stakeholder consultations).

The Intervention Working Group also submitted a planning and dissemination proposal to CIHR (answer expected in June 2022), that aim at:

1) Developing a Canadian mapping of municipal stakeholders, researchers, citizens, and private businesses willing to get involved in collaborative development and implementation Lyme disease risk reduction interventions.

2) Conducting an environmental scan to identify Lyme disease high risk areas with significant at-risk populations where Lyme disease interventions have a potential for being adequately implemented, locally managed, and evaluated by collaborative efforts of the research team and local stakeholders.

3) Sharing scientific knowledge and local experience and identify key components of Lyme disease risk reduction integrated interventions that could be applied and evaluated in each municipality's specific context during a two-day workshop with citizens, municipal stakeholders, and researchers.

Modelling Working Group

This group has oversight of the "modelling and mapping" component of the Risk Reduction Innovation Program. The objectives of the group are to facilitate modelling to support public health policies and programs directly, and to develop hypotheses on factors determining transmission of tick-borne pathogens. including modelling current spatial occurrence, spatial spread, and impacts of interventions. The group also aims to facilitate modelling of the ecology of tick-borne disease to develop hypotheses on environmental determinants of transmission, the transmission dynamics of different strains, and impacts of climate and other environmental/land use/socio-economic changes.

Research questions:

The group aims to use modelling of the ecology of tick-borne disease to develop hypotheses on environmental determinants of transmission, the transmission dynamics of different strains, and impacts of climate and other environmental/land use/socio-economic changes.

Expected outcomes:

Increased understanding of tick-borne disease transmission to support public health policies and programs including understanding current spatial occurrence, spatial spread, and impacts of interventions.

2021-22 Activities:

While most work was on hold due to COVID-19, CLyDRN-related work on modelling of spatial spread of *I. scapularis* and tick-borne agents continued at Université de Montréal, with two articles published in the last year. In 2021-22 the working group also developed a proposal for their seed funded project for the development of models of Lyme disease risk, which was submitted to the Network for review in the Winter 2022. The project was developed in consultation with the PCAC members and was recently approved by the CLyDRN Executive Committee. The project activities are expected to start in the summer 2022.

The main research objectives of the project are to:

1) Assess the impact of recreational activity change due to COVID-19 social distancing interventions on Lyme disease incidence.

2) Explore further how density-dependent processes in tick parasitism of wild animal hosts (tick attachment, density-dependent resistance, and grooming) and pathogen transmission (via "super spreaders" that carry high tick burdens, and effects on co-feeding transmission) may be impacted by how climate change may alter seasonality of ticks.

Pillar 3 (Clinical Science & Health Service Research)
(CO-LEADS: Twylla Bird-Gayson, Rob Brison, Mark Loeb, Beate Sander, Elizabeth Stringer & Terrie Wainwright)

Pillar 3 has two main projects: COHORT study and CLYME (Biobank) study.

The COHORT study examines the longitudinal health and economic impact of Lyme disease, identifies predictors of recovery, and will lay the foundation for future Lyme disease research in Canada. Various Lyme disease and healthy control participants will be recruited into the study and include: (1) patients with confirmed Lyme disease (symptoms of Lyme disease and Lyme serology test is positive), these would be your early localized, early disseminated, and late disseminated Lyme disease cases; (2) the Hypothesis Generating-Comparison Group, which includes patients with flu-like illness but without your typical Lyme disease rash and the Lyme serology test is positive; (3) Secondary Cohort-Comparison Group, which includes clinical symptoms of Lyme disease and the Lyme serology test result is negative; and (4) your healthy controls. Study participants are then followed at Baseline, 1-month, 3-months, 6-months, 9-months, 12-months, and 24-months. The prospective case-control study mentioned under Pillar 2 is a sub-study to the COHORT study.

The CLYME (Biobank) study was created to collect and store specimens (blood, urine, other fluids) and clinical data for future Lyme disease research projects. Culturing Borrelia from human samples (blood and tissue biopsy) is also occurring for this study. Lyme disease patients and healthy controls will be recruited. The Lyme disease patients are not stratified as mentioned in the COHORT study.

There are two recruitment sites for both studies, including the prospective case-control study, which are Lunenburg, NS and Kingston, ON.

Pillar 3 commenced participant recruitment for the Lyme disease participants at the Kingston, ON site for the CLYME (Biobank) and COHORT studies in the spring 2021 as a pilot project, led by Dr. Rob Brison. By the fall 2021, 20 participants had been enrolled into the CLYME (Biobank) study while 9 participants had been enrolled into the COHORT study completing their Baseline visit. From this initial Lyme disease cohort, 16 and 8 participants completed their 1-month follow-up visit for the CLYME (Biobank) and COHORT studies, respectively. 4 participants withdrew from further participation and did not complete their 1-month follow-up visit: 1 participant was enrolled in both studies

while 3 participants were only enrolled in the CLYME (Biobank) study. All 8 participants completed their 3-month, 6-month, 9-month, and 12-month follow-up visits for the COHORT study. The 24-month follow-up visits are scheduled to occur in the summer/fall 2023 for the first group of Lyme disease participants recruited into the studies during the 2021 Lyme disease season.

Pillar 3 members (scientists, research team members, patient partners) continued to meet monthly over the past year. As a result of the discussions and evaluation of the pilot project at the Kingston, ON site, staffing was enhanced at both sites (in preparation for the 2022 Lyme disease season) and study documents (informed consent forms, protocol, and data collection forms (eFORMS)) were reviewed to add additional data collection and find efficiencies in the process and help to streamline the in-person study visits for participants which were lengthy and time-consuming for the COHORT study. Amended study documents were submitted to the local REBs for the Kingston, ON and Lunenburg, NS sites and ethical clearances were obtained in the spring 2022.

On May 1, 2022, participant recruitment was re-launched at the Kingston, ON site for the Lyme disease and healthy control participants for the CLYME (Biobank) and COHORT studies (including the Pillar 2 prospective case-control study). Throughout 2021 and winter 2022, the Lunenburg, NS research team, led by Dr. Elizabeth Stringer, worked on site logistics to get their recruitment site ready to start participant recruitment and sample processing for the 2022 Lyme disease season. On August 24, 2022 participant recruitment was launched at the Lunenburg, NS site for the CLYME (Biobank), COHORT, and Pillar 2 prospective case-control studies.

The total number of participants enrolled into all three studies during the 2021 and 2022 Lyme disease seasons for both recruitment sites can be found below:

CLYME (Biobank) Study:

Lyme disease:

	Kingston, ON Site	Lunenburg, NS Site
Participants had been enrolled (consented) into the study	59	0
Participants completed the Baseline study visit	49	0
Participants completed the 1-month study visit	37	0
Participants withdrawn from study or lost to follow-up	13	0
Participants refused to participate in study	39	unknown

Healthy controls:

	Kingston, ON Site	Lunenburg, NS Site
Participants had been enrolled (consented) into the study	0	0
Participants completed the Baseline study visit	0	0
Participants completed the 1-month study visit	0	0
Participants withdrawn from study or lost to follow-up	0	0
Participants refused to participate in study	60	unknown

COHORT Study:

Lyme disease:

	Kingston, ON Site	Lunenburg, NS Site
Participants had been enrolled (consented) into the study	31	0
Participants completed the Baseline study visit	27	0
Participants completed the 1-month study visit	20	0
Participants completed the 3-month study visit	8	0
Participants completed the 6-month study visit	8	0
Participants completed the 9-month study visit	8	0
Participants completed the 12-month study visit	8	0
Participants completed the 24-month study visit	0	0
Participants withdrawn from study or lost to follow-up	5	0
Participants refused to participate in study	39	unknown

Healthy controls:

	Kingston, ON Site	Lunenburg, NS Site
Participants had been enrolled (consented) into the study	0	0
Participants completed the Baseline study visit	0	0
Participants completed the 1-month study visit	0	0
Participants completed the 3-month study visit	0	0
Participants completed the 6-month study visit	0	0
Participants completed the 9-month study visit	0	0
Participants completed the 12-month study visit	0	0
Participants completed the 24-month study visit	0	0
Participants withdrawn from study or lost to follow-up	0	0
Participants refused to participate in study	60	unknown

Prospective Case-Control Study (Pillar 2):

Healthy controls:

	Kingston, ON Site	Lunenburg, NS Site
Participants had been enrolled (consented) into the study	45	0
Participants completed the Baseline study visit	45	0
Participants withdrawn from study or lost to follow-up	0	0
Participants refused to participate in study	20	unknown

Pillar 4 (Patient and Community Engagement, Training & Knowledge Translation)
(CO-LEADS: Cécile Aenishaenslin, Ryan Egan, Janet Parsons & Tamara Rader)

Pillar 4 has been able to continue its work, with some delays, despite the challenges presented by the pandemic and the secondment of researchers to COVID-19 related research. We have completed and published a systematic review of research into the effectiveness of Lyme disease knowledge translation and training of the general population and health care practitioners (https://doi.org/10.1080/14635240.2021.1920045) and we have completed a grey literature review of global information, training resources, and courses available to healthcare practitioners in Canada (https://doi.org/10.1177/21501327211050744).

Forty-three (43) virtual interviews with national healthcare practitioners (family physicians, nurse practitioners, infectious disease specialists, cardiologists, rheumatologists) on the current diagnostic and treatment approaches to both acute and post treatment Lyme disease, and the resources they use to inform their approaches and decisions, were completed. These interviews are currently being analyzed. There has been continued engagement with patient partners on all stages of the research study. At multiple meetings patient partners provided valuable feedback and recommendations on the design and implementation of interviews. Lyme disease patients contributed to the study by completing an anonymous survey indicating potential health practitioners to approach for recruitment into this study. For the next reporting period, there will be focus on completing the analysis for the healthcare practitioner interviews and manuscript writing.

Development of the Knowledge Translation and Training (KTT) porthole continues in earnest through a full process of consultation with Network scientists, and both internal (PCAC and Community Advisory Committee (CAC)) and external patient and community stakeholders. The KTT porthole is envisioned as a national resource for consolidation and translation of primary (often controversial) Lyme disease research data. A proof of concept will be developed for one (1) module, along with creating the platform infrastructure to allow for future modules to be added when additional funding is secured. This task will take 12-18 months to complete. Input from CLyDRN Executive Committee, Pillars/Committees Network Leads, PCAC, and our new CAC will be collected on the top topics to cover. In addition, the results of the Pillar 4 focus group discussions, Brokered Dialogue project, grey literature review, and systematic review will help to shape the initial

discussions. We will also solicit external feedback from Lyme advocacy groups and other external community stakeholders, including input from our Indigenous communities. The KTT porthole will also help to provide a platform for Lyme advocacy groups and Lyme disease patients/caregivers to connect and seek resources without necessarily becoming a member of CLyDRN or being a part of PCAC or CAC. The platform can also be used for patients and caregivers to get together for peer support. The KTT porthole will also be shaped by future research directions of the Network (i.e., expansion to include tick-borne diseases). For these reasons further development of the KTT porthole is on temporary hold until Network and stakeholder discussions occur later in the fall 2022.

A partnership was developed with the eTick team (Bishop University) to develop an interactive web tool on tick bite and tick-borne disease prevention. This web tool is called TickTOOL (PraTIQUE in French) and will be used to translate knowledge generated on this topic by Pillar 4. This tool is different from the KTT porthole which will not focus on prevention but will be linked with the KTT porthole. The content is currently being developed.

The Brokered Dialogue project will focus on patient and caregiver practices in managing Lyme disease (from diagnosis through treatment to ongoing management of chronic sequelae) and how these relate to the practices of other stakeholders (i.e., clinicians, policymakers, and others). The working group (which includes patient partners) met during 2020-2022 and in consultation with them and the PCAC members, the project finalized its protocol and received ethical clearance to commence. To move this project forward following the pandemic, the working group is planning a first phase of in-depth audio recorded interviews, which can be collected remotely (by phone or ZOOM) with patients, caregivers, and other stakeholders. The data collected will serve as a foundation for the filmed interactive interview portion of the study (Phase 2). Participant recruitment and data collection are underway for Phase 1, with Phase 2 beginning later in fall 2022/winter 2023. This study will employ the GRIPP2-SF checklist tool for reporting on patient and community engagement activities.

In relation to the community engagement process, we have undertaken a community stakeholder mapping exercise with the CLyDRN Executive Committee, Network Leads, and PCAC members to identify a list of organizations across Canada to outreach about the opportunity to join a new advisory group with a focus on community activities and strategies. The new committee (CAC), comprised of community groups and external stakeholders outside of patients and family caregivers (including parks and recreation, fishery, forestry, farming, and Indigenous communities), was formed and 7 community

members have been recruited to date. An information flyer was created for disseminating the call for additional community members to join the committee. The work of recruitment will be ongoing. The CAC held its first meeting in June 2022. A community outreach event also occurred on August 27, 2022, at the Discovery Centre, Halifax, Nova Scotia. Alongside the showing of the *Traveling Tick Exhibit: Ticks—Little Bugs, Big Problems* a Network research staff was present at the Discovery Centre to connect with museum patrons visiting the exhibit and share information about the Network.

A doctoral student (Claire Hiscock) supervised by Pillar 4 scientists (Clara Juando-Prats and Janet Parsons) along with an Indigenous scholar (Professor Angela Mashford-Pringle) has been working with the Simcoe Muskoka District Health Unit in developing relationships with several Ontario First Nations with a view to eventually co-create a project that explores experiences and perspectives of First Nations people living in these communities regarding tick-borne illnesses. This important relational work will be of central importance to the future relevance of the Network.

A qualitative research study was conducted to understand the drivers of healthy preventive behaviors against Lyme disease of the Canadian population. The study will investigate the impacts of tick bite exposure and the barriers/facilitators to the adoption of preventive behaviors amongst the general population. Interested Pillar 4 and PCAC members were invited to contribute to this project as co-researchers in winter 2020. The preliminary protocol was shared with Pillar 4 and PCAC members, and written feedback provided was incorporated into the final protocol. Twenty-two (22) focus group discussions were conducted with a total of 96 participants located in five regions with endemic Lyme disease in Canada: BC (n=5), MB (n=21), ON (n=22), QC (n=26), and NS (n=22). Interested PCAC members were also invited to participate in the interpretation and validation of results and in the writing of a co-authored publication, all of which will be occurring during the next reporting period. The results from this study will be used to guide the development of a questionnaire that will be applied for the pan-Canadian survey.

The pan-Canadian survey on exposure to ticks and knowledge, attitudes, and practices regarding Lyme Disease in the general population has been delayed given that qualitative results from the focus group discussions were needed to consolidate the questionnaire. This survey study will investigate the adaptation of the Canadian population to ticks and Lyme disease. This study will also allow to quantify tick exposure across Canada, and to test this indicator as an indicator of risk for Lyme disease. We do not anticipate other delays or risk related to this deliverable, given that the survey will be conducted online

(web-based panel) and is not subject to restrictions of cancellation due to the pandemic. Interested Pillar 4 and PCAC members were invited to contribute to this project as co-researchers. The research protocol was shared with PCAC members for comments and discussion. The study received ethical clearance to commence in the spring 2022. Data collection is now scheduled to start in the summer 2022. Data analysis will be conducted in fall 2022. The working group does not envision any further delays in carrying out the study following the pandemic for reasons already identified above.

Pillar 4 Co-Lead Tamara Rader has been leading the implementation and evaluation of the GRIPP2-SF checklist tool (guideline to improve reporting of patient and public involvement in research) across the Network along with PCAC member and CLyDRN Executive Committee member Nancy Garvey. We are amid a paradigm shift, actively involving patients, family caregivers, and community members in various research processes (citizen science). The patient and community perspectives are integrated into every step of the research process including developing research questions, defining research objectives, collecting data, and evaluating results, and we can work together through active collaboration and building consensus. The international experience with engaging citizens and patients in research has shown that involving them early in the design of studies, ideally as early as at the planning stage, leads to better results. Various projects within Pillars 1, 2, and 4 will employ the GRIPP2-SF checklist tool as part of the pilot roll-out throughout the Network. The pilot projects completing the GRIPP2-SF checklist tool will be a good learning tool for other researchers in the Network. PCAC members will facilitate and advise on the wording and format of the completed forms. This pilot initiative will provide an excellent opportunity for standardization of engagement efforts in reflective research practices across the Network and can be used by all research teams when submitting papers for publication.

Pillar 4 next steps involve: (1) outreaching to Lyme disease advocacy and support groups; (2) onboarding new members (patient, family caregivers, and community partners) into PCAC and CAC; (3) increasing participation of internal and external stakeholders at CLyDRN events; (4) completing the Brokered Dialogue project; (5) initiating the Pan-Canadian survey in summer 2022; (6) designing and conducting scoping review focused on Indigenous experiences and perspectives on Lyme disease; and (7) rolling out and evaluating the GRIPP2-SF checklist tool in a number of pilot projects.

Patient and Community Advisory Committee
(CO-LEADS: Clara Juando-Prats & Tamara Rader)

The PCAC members have been working since the beginning of the Network on engaging patients, family caregivers, and members of the community in all aspects of the Network based on CIHR's Strategy for Patient Oriented Research (SPOR) Framework. PCAC's activities have focused on: (1) expanding the number of patients and community members partnering and collaborating with the Network, and increasing the diversity of the committee in terms of geographical representation and age; (2) establishing and maintaining the communication between PCAC members and the leads and other members of the Network; (3) representing the PCAC in all the Pillars and Committees and participating in the existing working groups; (4) developing the implementation of the GRIPP2-SF reporting guideline to increase the quality and transparency of the reporting on patient and community engagement; (5) finalizing the research priority setting conducted with Pillar 1, after identifying the top research priorities for patients related to improving the diagnosis of Lyme disease in Canada; (6) developing a structure that helps increase the engagement capacity of the Network members; and (7) supporting an expanded community engagement process (inviting a broader range of stakeholders to join the Network), including developing relationships with Indigenous communities, under Pillar 4 activities.

During the past year, 112 people have contacted the PCAC through the open survey available through the CLyDRN website. Fifty-six (56) out of the 112 individuals indicated they are individuals living with Lyme disease or were a friend or family member of someone living with Lyme disease. During the year, the two Co-Chairs of the PCAC have regularly conducted orientation sessions with individuals interested in partnering or collaborating with the Network. Today, the PCAC has 35 active members which has resulted in an enriched and diverse range of perspectives, skills, and experiences advising and working with the rest of the CLyDRN members; the members contribute and collaborate in different ways based on their availability and skills. PCAC was also involved with helping to identify relevant community stakeholders to join the new CAC. We are continuing to recruit new patient and caregiver members to the Network.

Patient partners have taken on leadership roles in Pillars, Committees, and sit on the CLyDRN Executive Committee. The PCAC has continued growing and patient partners are acting in Co-Chair/Co-Lead roles for Pillars 1 to 4, PCAC, and for the Project Grants Committee. The CLyDRN Executive Committee has 3 patient partners as active decision

makers. The PCAC has been actively offering support and encouragement to members to collaborate across Pillars, Committees, and other sub-working groups and special initiatives. Patient partners continue to make pivotal contributions to the work of the Network through various advisory, collaborative, and/or decision-making roles depending on their availability. PCAC members are co-leading the development of the Pillar 1 research project and shaping the work of multiple projects under Pillar 2 and 4. As an example, the modelling working group and intervention working group (both under Pillar 2) and researchers for the qualitative preventive behaviors study and Brokered Dialogue study (both under Pillar 4) presented their research proposals to PCAC members and incorporated their feedback and recommendations into their final proposals. Of recent note is the leadership of PCAC members in planning and running last year's virtual AGM (November 2021). PCAC members also co-designed the 2022 Lyme Disease Awareness Month (May 2022) to increase the profile of internal and external research activities occurring in Lyme disease and tick-borne disease research.

During the past year, we hosted 5 PCAC meetings, allowing for a break in December 2021 around the holidays, a break for members to prepare for the AGM in the fall of 2021, and a break in May 2022 so members could join the Lyme Disease Awareness Event month activities. As part of the engagement strategy to develop and strengthen communication between CLyDRN scientists and PCAC members, we have invited on a regular basis scientists and students from the Pillars to present and discuss their work; this has proved extremely beneficial and engaging for both groups and we will continue with this approach in the upcoming year.

One of the challenges faced by the PCAC is the difficulty to get representation from all provinces and territories (e.g., Nunavut, Yukon, Northwest Territories, Newfoundland & Labrador) – this could be related to differing perceptions of risk among residents in different regions of the country. As we know, tick populations and Lyme disease risk are not uniformly distributed across Canada. Engagement with Indigenous communities is also a priority. Another challenge is having greater representation in terms of gender diversity and from members of racialized communities. A related challenge is the difficulty to partner with Canadian Lyme disease advocacy groups. However, thanks to the conversations that started during the Lyme Disease Awareness Month events held in 2021 and 2022, we continue to build relationships with different Lyme disease patients' advocates, and we are hoping to work together in planning the future direction and activities of the Network, including knowledge translation strategies for 2022-2023 and beyond. During the next year the PCAC members have the goal of initiating more

conversations with the advocacy groups and invite them to a PCAC meeting to create a space for learning, creating, and discussing.

During the next reporting period our efforts will focus on: (1) implementing the use of the GRIPP2-SF reporting tool across the Network, training investigators in its use, and supporting its adoption; (2) continuing the support to all PCAC members and capacity building so everyone feels comfortable in their roles as research partners or advisors or decision-makers; (3) strengthening and facilitating the communication between all Network stakeholders; (4) working with the Network Leads and the CLyDRN Executive Committee to ensure that patients preferences, priorities, experiences, and needs are valued and incorporated in the work (current and future) of the Network; (5) onboarding new patient partners into the Network with a focus on diversity; and (6) taking definite and positive steps to enhance and integrate patient and citizen engagement into all future activities of the Network through patient-led engagement initiatives. We will also continue to work with the Project Grants Committee to find relevant funding opportunities to translate into fundable research patient-identified questions, and we will begin writing and disseminating of the process and activities and lessons learned by the PCAC through the work done for and with the Network.

Trainee Advancement Committee
(previously named Training Advisory Committee)
(CO-LEADS: Natasha Bowser & Katie Clow)

The Trainee Advancement Committee (TAC) has two Co-Chairs, one of which is a trainee and the other a scientist. The previous trainee Co-Chair (Benoit Talbot) stepped down in the spring of 2021 from their position and we recruited a new Co-Chair (Natasha Bowser) in November 2021.

Following a period where attendance at TAC webinars had been low (due in part to the pandemic and Zoom fatigue), an email was sent out to all CLyDRN members in December 2021 to promote awareness of the committee and invite interested people to join. This provided a chance to refresh the email list of members. The name was also changed to Trainee Advancement Committee (from Training Advisory Committee) to make it clearer that the committee was for trainees.

In January 2022, an online survey was distributed to the forty-one (41) people on the TAC mailing list, designed to find out the composition of members, what members wanted from the TAC (e.g., learning, training, knowledge sharing, networking, particular subjects), how they preferred to stay in communication, and availability for TAC events. It was clear that members had missed the networking opportunities which were not available during the pandemic.

TAC members met in February 2022 to discuss the needs for the upcoming year. This was a highly beneficial meeting and helped determine the direction for the upcoming year. TAC has hosted/will host four (4) events over the academic year:

- Networking Event (February 2022).
- "*Communicating with Media*" webinar with Deirdre Healey (March 2022).
- Networking Event (June 2022).
- *"Veterinary and zoonotic aspects of Lyme disease"* webinar with Dr. Katie Clow (September 2022).

TAC members also had an opportunity to attend the 2021 AGM and the 17 Lyme disease and tick-borne disease presentations held throughout May 2022 for Lyme disease awareness month. A few of the TAC members presented at the May 2022 event. All webinars and student/trainee presentations were recorded and uploaded to the CLyDRN

members portal so those students/trainees who could not attend had access to watch the webinars.

The 2022 AGM is scheduled to take place in the fall 2022, and TAC members will have an opportunity to come together virtually. We will engage with TAC members to find out how many are likely to attend, which activities they would like to participate in (e.g., poster sessions, speed oral presentations, other networking events) and which subjects/speakers they would like to hear for the plenary session and panel discussion.

It is unknown if any patient, family caregivers, and community partners participate in TAC events. We widely advertise across the Network and have communicated at the AGM that all are welcome to come and learn. In our survey, none of the respondents identified as patient, family caregiver or community partners. In the next year we will continue to invite all CLyDRN members to the TAC and to try and offer a variety of training and networking opportunities. For the next reporting year, TAC can investigate the possibility of inviting one or more of the Lyme disease advocacy groups to speak with TAC members. This could be in the form of a panel (hosted by CLyDRN), or a presentation. As well as promoting collaboration this would also respond to requests for certain types of training by some TAC members.

Our greatest challenge has been with trainee engagement. We have had an increase in trainee involvement following a soft "relaunch" of the committee this year. Given the response to the survey and the helpful insight it provided, we will endeavour to conduct one at the beginning of each academic year to ensure our efforts align with the current student and trainee priorities.

Project Grants Committee
(previously named Fundraising Committee)
(CO-LEADS: Rob Colautti, Clara Juando-Prats, Maarten Voordouw & Terrie Wainwright)

The Project Grants Committee supported a New Frontiers Exploration grant led by Tim Salomons and Rylan Egan, based on priorities identified by PCAC members. This is a small exploratory grant with three small pilot projects: (1) testing diagnostic potential of symptom profiles; (2) comparing urine-based biomarkers in relation to symptoms and diagnosis; and (3) evaluating diagnostic practices and impact on patients. This project would also be using the GRIPP2-SF checklist tool for capturing patient and community engagement. Unfortunately, the project grant application was not successful in being funded; the Committee will look to re-apply in future grant competitions.

The Committee worked with student clubs at Queen's University in the planning of a week-long virtual "*Lyme Disease Hack-a-thon*" for junior undergraduate students. Edge of Lyme is a hack-a-thon style competition in which students from all disciplines form teams and collaborate to solve various problems in the world of Lyme disease. The goal is to generate interest and awareness about Lyme disease through experiential learning that includes brainstorming new ideas for detection and monitoring of tick-borne diseases. The event took place in January 2022.

The Committee, through Queen's University, participated in *Science Rendezvous*: a virtual and in-person event for children and families held at various sites across Canada throughout May 2022. The Queen's research team shared information with the public on tick safety and raising awareness for Lyme disease through various activities.

Rob Colautti presented at the Kingston-Syracuse Pathway Conference in June 2022, which is a collaboration between Queen's University and SUNY (State University of New York) to advance cross-border collaborations in research, innovation, and economic development. The accomplishments of the Network to date, including the research projects under the Committee, were presented.

The Committee changed its name from the Fundraising Committee to the Project Grants Committee in the spring 2022. This "revamped" committee (~10-12 members) now plans

to focus its efforts on finding ways to help translate priorities identified from our patients, family caregivers, and community stakeholders through engagement and collaboration into fundable new research grants. A first meeting occurred in July 2022 and the Committee will meet quarterly. The next meeting is scheduled to occur in the fall 2022.

Several CLyDRN members were part of many research teams across Canada that submitted a Letter of Intent (LOI) to the Public Health Agency of Canada's call for the Infectious Disease and Climate Change Program. Patrick Leighton also submitted a LOI, on behalf of CLyDRN, to build a national tick-borne disease research network (TickNet Canada) to expand the scope of our existing research focused on Lyme disease to consider the full spectrum of tick-borne diseases in Canada. The LOI has been selected to move forward to a full application.

Our focus for the next fiscal year will be to continue to: (1) identify research priorities; (2) identify funding opportunities; (3) support collaborative grants involving Network members; and (4) increase more active involvement from Network members to assist with writing grant applications and/or sit on the Committee in an advisory role.

CLyDRN Events
(Planning Committee: Terrie Wainwright & Veronica Harris-McAllister)

Annual General Meeting

The Annual General Meeting (AGM) was held on November 10, 2021. Pillar and Committee updates were provided to CLyDRN members and external stakeholders about the Network's research projects, activities and initiatives carried out during the last fiscal year (2020-2021).

We are planning for the 2022 AGM to be held virtually in the fall 2022, where our Pillars and Committees will provide an update on their activities over the past year, our students and trainees will have oral and poster presentations, we will have guest speakers for our plenary session and panel discussion, and we will have opportunities for networking. A special task force with 10 members was struck in the winter 2022 to plan out the logistics for the Network event. We had originally planned for an in-person AGM to be held in Toronto, Ontario but with recent public health restrictions placed at academic institutions starting the fall 2022, booking academic facilities has become a challenge. Instead, we have shifted our Network event to another virtual event for the 2022 AGM. We will aim for an in-person AGM to occur in the fall 2023 which will be our first in-person event since 2019 AGM.

Network Leads workshop is also being planned during the fall 2022 to allow the CLyDRN Executive Committee, Network Leads, and identified key internal/external stakeholders to start planning for future Pillar and Committee activities, hold preliminary Network visioning exercises, and start to search for funding opportunities to sustain and grow the Network over the coming years.

Lyme Disease Awareness Event

The CLyDRN Lyme Disease Awareness Month is a great opportunity to help raise awareness for Lyme disease and to let Canadians know all about the amazing work that our Network, external research groups, and Lyme advocacy groups have been doing to help raise awareness, demystify and "*Take a bite out of Lyme*". Throughout the month of May 2022, 22 speakers delivered 17 presentations on various Lyme disease and tick-borne disease topics:

- *Handheld microbiome sequencing to detect, identify, and monitor tick-borne pathogens* (Dr. Sima Afsharnezhad - Post-Doctoral Fellow)

- *Spatial and temporal patterns of the blacklegged tick (Ixodes scapularis) and Lyme disease in Ontario, Canada: Making a case for a One Health surveillance approach* (Cyril Akwo - PhD Student)

- *Lyme disease and infection associated chronic illnesses* (Dr. John Aucott)

- *Lyme Carditis: Do I need to be checked?* (Dr. Adrian Baranchuk)

- *Morphometric and genetic variation in Ixodid ticks at an expanding range edge* (Damian Bourne - Master's Student)

- *The Canadian Lyme Sentinel Network (CaLSeN): results from a new surveillance initiative tracking tick-borne disease risk across Canada* (Dr. Katie Clow, Camille Guillot - PhD Student & Dr. Patrick Leighton)

- *Lyme Disease and Pregnancy: The Value of Research Partnerships* (Dr. Elizabeth Darling & Sue Faber)

- *Anaplasmosis and other less common tick-borne infections* (Dr. Gerald Evans)

- *Invaluable Inheritance: Co-infection with multiple strains in the mother reduces the protective efficacy of the maternal antibody response in the offspring* (Alexandra Foley-Eby - PhD Student)

- *Updates in the Pathogenesis of Borrelia burgdorferi* (Dr. Leona Gilbert)

- *Ticks from Humans in Alberta* (Dr. Daniel Gregson)

- *The Future of Lyme, Tick-borne Disease and Global Health Challenges in the 21st Century* (Dr. Richard Horowitz)

- *Co-creating a dialogue with patients, families and other stakeholders concerning Lyme disease* (Dr. Clara Juando-Prats & Dr. Janet Parsons)

- *Passive Tick Surveillance in BC: What we have learned so far* (Dr. Muhammad Morshed)

- *Lyme Disease Prevention: A summary and discussion of where we stand on Lyme Vaccines and other immune mediated approaches* (Dr. Mark Soloski)

- *Pediatric Lyme arthritis: the next wave of Lyme disease in children?* (Dr. Elizabeth Stringer)

- *Lyme Carditis: A 2022 Update for Patients, Health Care Providers and Researchers* (Dr. Rachel Wamboldt - Research Fellow & Dr. Chang (Nancy) Wang - Resident)

On average 40-45 participants (patients, family caregivers, Lyme advocates, community members, scientists, students, and trainees) tuned in each day to listen to the presentations. The presentations were recorded, and the videos were uploaded onto the members portal on the CLyDRN website to allow CLyDRN members an opportunity to watch any of the webinars missed. The presentations were also posted on the CLyDRN website on the public-facing domain to share the videos with external stakeholders. During the event we also held a photo challenge: wear green or wear a green face mask, take a photo, and share it with us to help spread awareness of Lyme disease. In total six (6) photo/drawing entries were received for the May event competition, and each entry received a $25 Starbucks e-gift card (donated by the CLyDRN Network Management Office).

Planning for the 2023 Lyme Disease Awareness Month event will commence later in 2022.