VOL. 3 | ISSUE 1 | 2024 EDITION

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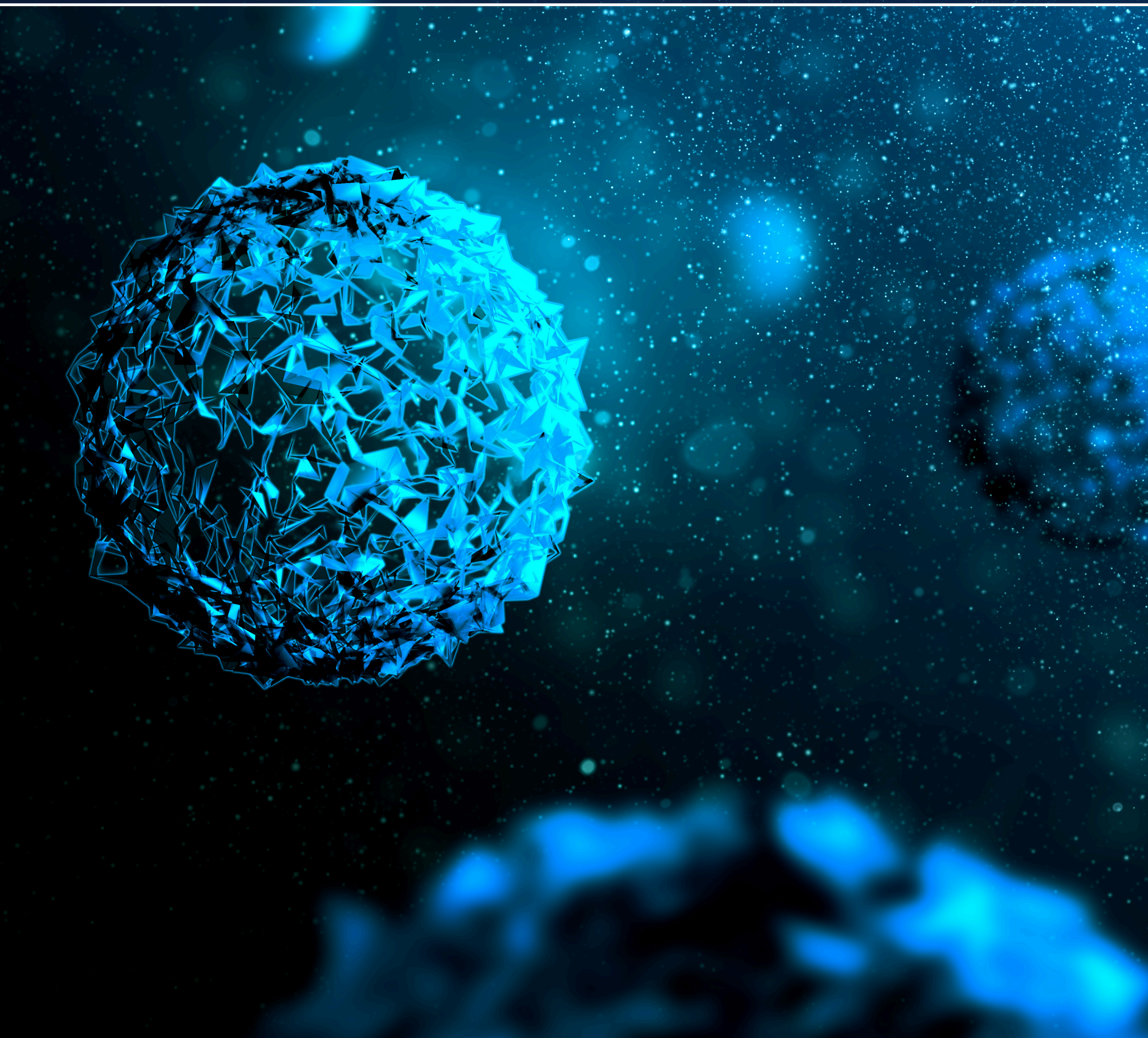
UNIVERSITY OF OTTAWA SCIENCE UNDERGRADUATE RESEARCH JOURNAL



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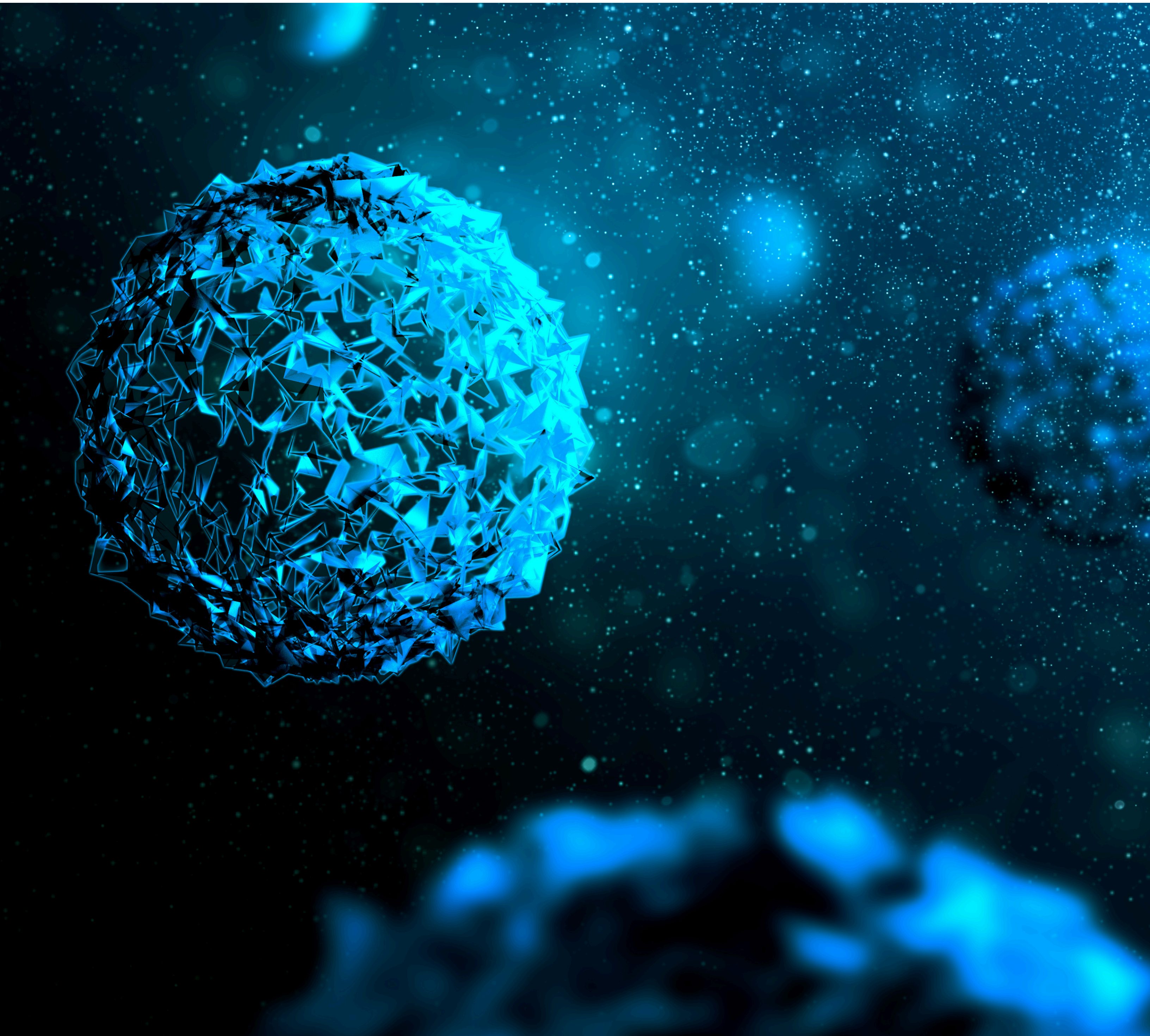

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UNIVERSITY OF OTTAWA SCIENCE UNDERGRADUATE RESEARCH JOURNAL

Editorial Team

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ORIGINAL RESEARCH

The Analysis of eTick Submission in Ontario

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Abstract

Purpose: *Ixodes scapularis*, also known as the eastern blacklegged tick, is associated with vectorborne Lyme disease in North America [1][2]. Warming temperatures due to climate change are increasing the number of areas suitable for ticks, and contributing to the expansion of tick species in Canada [3]. The purpose of this project was to identify recent trends in tick range expansion and species diversity in Ontario by analyzing 2019 to 2022 data from the web-based tick surveillance platform, eTick.ca.

Method: The eTick.ca web platform allows the public to submit tick photos for identification. We extracted data from the tick submissions for Ontario between mid-2019 and 2022, including information on the species, host type, travel history, and location. Microsoft Excel was used to generate distribution tables and graphs of tick submissions by species, month/year, and host type for Ontario. Geographic Information Systems (ArcGIS) and SaTScan software were used to identify spatial clusters of tick submissions adjusting for the human population size using Ontario census subdivisions.

Results: A total of 14,611 tick photo submissions were recorded between 2020 and 2022, excluding those with a history of recent travel. The year 2021 had the highest number of submissions (n = 7339).
Dermacentor species comprised the majority of submissions (n = 9498, 65%), followed by I. *scapularis* (n = 4810, 33%) and other species (n = 303, 2%) between 2020 and 2022. Ticks were most commonly discovered on human hosts (n = 10,084), followed by animal hosts (n = 3485), and finally, free in the environment (n=1042). Additionally, the majority of species were found in the adult stage (n = 12,821, 88%), followed by unknown stage (n = 1539, 10%) and immature stages (n = 251, 2%). Clusters of I. *scapularis* were present in the Eastern, Central, and Southern Ontario regions, while clusters of *Dermacentor* sp. were present in Southern and Central Ontario regions.

Conclusion*:* Spatial and temporal variations in tick submissions in Ontario were identified over the 3.5-year period since the implementation of eTick in the province. Data from eTick can be used to identify hotspots of human-tick exposure.

Résumé

Objectif : *Ixodes scapularis,* aussi connue sous le nom de tique à pattes noires, est associée à la maladie de Lyme à transmission vectorielle en Amérique du Nord [1][2]. Le réchauffement des températures dû au changement climatique augmente le nombre de zones propices aux tiques et contribue à l'expansion des espèces de tiques au Canada [3]. L'objectif de ce projet était d'identifier les tendances récentes de l'expansion de l'aire de répartition des tiques et de la diversité des espèces en Ontario en analysant les données de 2019 à 2022 de la plateforme de surveillance des tiques en ligne, eTick.ca.

Méthode : La plateforme web eTick.ca permet au public de soumettre des photos de tiques pour identification. Nous avons extrait des données des soumissions de tiques pour l'Ontario entre la mi-2019 et 2022, y compris des informations sur l'espèce, le type d'hôte, l'historique des voyages et l'emplacement. Microsoft Excel fut utilisé pour générer des tableaux de distribution et des graphiques des soumissions de tiques par espèce, mois/année et type d'hôte pour l'Ontario. Les systèmes d'information géographique (ArcGIS) et le logiciel SaTScan furent utilisés pour identifier les grappes spatiales de soumissions de tiques en ajustant la taille de la population humaine à l'aide des subdivisions de recensement de l'Ontario.

Résultats : Au total, 14 611 soumissions de photos de tiques furent enregistrées entre 2020 et 2022, en excluant les personnes ayant des antécédents de voyages récents. L'année 2021 a enregistré le plus grand nombre de soumissions (n = 7339). Les espèces *Dermacentor* représentaient la majorité des soumissions (n = 9498, 65%), suivies par I. scapularis (n = 4810, 33%) et d'autres espèces (n = 303, 2%) entre 2020 et 2022. Les tiques furent le plus souvent découvertes sur des hôtes humains (n = 10 084), suivis par des hôtes animaux (n = 3485), et enfin, libres dans l'environnement (n = 1042). De plus, la majorité des espèces ont été trouvées au stade adulte (n = 12 821, 88%), suivie du stade inconnu (n = 1539, 10%) et des stades immatures (n = 251, 2%). Des groupes d'I. scapularis étaient présents dans les régions de l'Est, du Centre et du Sud de l'Ontario, alors que des groupes de *Dermacentor sp.* étaient présents dans les régions de l'Est et du Sud de l'Ontario.

Conclusion : Des variations spatiales et temporelles dans les soumissions de tiques en Ontario ont été identifiées sur une période de 3,5 ans depuis la mise en œuvre d'eTick dans la province. Les données d'eTick peuvent être utilisées pour identifier les zones à risque d'exposition humaine aux tiques.

Introduction

Lyme disease is a vector-borne infectious disease caused by Borrelia burgdorferi genospecies of bacteria, including B. burgdorferi sensu stricto (s.s.) in North America, B. afzelii in Europe, and B. garinii in Asia [1]. These bacteria belong to the Spirochaete class, with a long corkscrew-like shape that can dive into the host's skin. Ticks play a significant role by acting as vectors to transmit the bacteria to ahost [1]. In Ontario, *Ixodes scapularis*, also known as the eastern black-legged tick, is associated with vector-borne Lyme disease [2]. Other tick species in Ontario include *Dermacentor variabilis*, the American dog tick or wood tick, which can serve as a vector for Rocky Mountain spotted fever and tularemia. Climate change has promoted warming temperatures that are more suitable for tick populations, leading to the northward expansion of the species to new regions [3]. This study aimed to identify the recent trends in tick range expansion and species diversity in Ontario using 2019 to 2022 data from eTick.ca.

Methods

Data source
The eTick.ca web platform collects passive surveillance data on ticks in Canada. This platform allows the public to submit tick photos for identification by regional expert tick identifiers and allows the researchers to monitor tick populations in Canada. We extracted data from the tick submissions for Ontario between April 2019, when the eTick platform was first implemented in the province, and December 2022. The submission data included the type and life stage of tick species, host type, travel history, date, and location. Only valid submissions (i.e. submissions with confirmed species identification and location) were included in the analysis.

Descriptive analyses
Microsoft Excel software was used to calculate the total number of tick submissions by species, year, and host type. Since submission data for 2019 were not collected for all 12 months, the descriptive trend analyses focused on submissions between 2020 and 2022, representing years when the eTick platform was fully operational between January and December.

Spatial analyses
ArcGIS software was used to map the spatial distribution of *Ixodes scapularis* and *Dermacentor species (sp.)* submissions across Ontario census subdivisions (CSDs) between 2019 and 2022 [4]. SaTScan software, which allows users to analyze spatial, temporal and space-time data using the Kulldorf spatial scan statistics [5] was used for space-time cluster analysis on *Ixodes scapularis* and *Dermacentor species* submissions from 2021, to estimate the relative risk of clusters, adjusting for the human population size of each unit. The 2021 Census Boundary Files and 2021 Census Population files were downloaded from the Statistics Canada website and combined with the tick point location data (latitude/longitude of user-reported tick encounter locations) to aggregate tick submissions by CSD, and determine the hotspots of human-tick exposure.

Results

Trends in tick species over time
Between 2020 and 2022, there were 14,611 photo submissions of ticks found on humans, animals, and free in the environment, excluding those with travel history. The total number of submissions of *Dermacentor sp.* was higher than *I. scapularis* each year (Table 1). Of all three years when the eTick platform was fully operational, 2021 had the highest total number of submissions (n = 7,339), whereas the 2020 total was 2,961, and the 2022 total was 4,311. The variation in tick encounters may be due to changes in ecological and weather conditions, differences in human and animal exposure, and/or discrepancies in the promotion of the eTick platform across various public health units over time (Figure 1). *Dermacentor sp.* (65%) made up the majority of submissions, followed by *I. scapularis* (33%) and other species (2%) for 2020, 2021, and 2022 (Figure 2). Based on the monthly eTick submissions over the last three years, the number of *I. scapularis* submissions usually reached its peak between May and October. The pattern of this species typically started to rise in March, then gradually decreased in August, and began to increase again in September, persisting until December. Similarly, the number of *Dermacentor sp.* submissions elevated around March until August, reaching its highest point in May (Figure 3).

Trends by host type
The majority of tick submissions were found on a human host (n=10,084), followed by animal hosts (n=3,485), and free in the environment (n=1,042) (Table 2, Figure 4). Ticks were more commonly found on dogs than cats.

Trends by life stage
I. scapularis, and Dermacentor sp. were commonly found in the adult stage during their peaks, which were May and October for *I. scapularis* (Figure 5), and May for Dermacentor sp., followed in both cases by unknown and immature stages (Figure 6). The peak season for immature *I. scapularis* occurred around June annually (Figure 5), whereas immature Dermacentor sp. were rarely observed (Figure 6). Adult ticks made up the majority of species found (n=12,821, 88%), followed by unknown (n=1539, 10%), and finally immature stages (n=251, 2%) (Figure 7).

Spatial distribution and spatiotemporal cluster detection
Between 2019 and 2022, 6,305 *I. scapularis* submissions (Figure 8) and 11,370 Dermacentor sp. submissions (Figure 9) were recorded across Ontario. In 2021, when the highest number of tick photo submissions were recorded, there were 2,440 *I. scapularis* submissions, corresponding to 160.7 per 100,000 population, and 5,975 *Dermacentor sp.* submissions, corresponding to7804.9 per 100,000 population.

Using retrospective space-time analysis, with submissions aggregated at the census subdivision level and adjusted for population size, high-rate clusters of I. scapularis were identified in Southern and Eastern Ontario. A large cluster spanning Eastern Ontario was detected between June and November, while three clusters in Southeastern Ontario, including clusters over the north shore of Lake Erie, the north of Toronto and the Greater Toronto Area were detected from October to November (Table 3, Figure 10). Two high-rate clusters of *Dermacentor sp.* were identified between April and July, including a large cluster encompassing the area between Windsor and the Greater Toronto Area and a smaller cluster in the Kawartha Lakes region (Table 4, Figure 11).

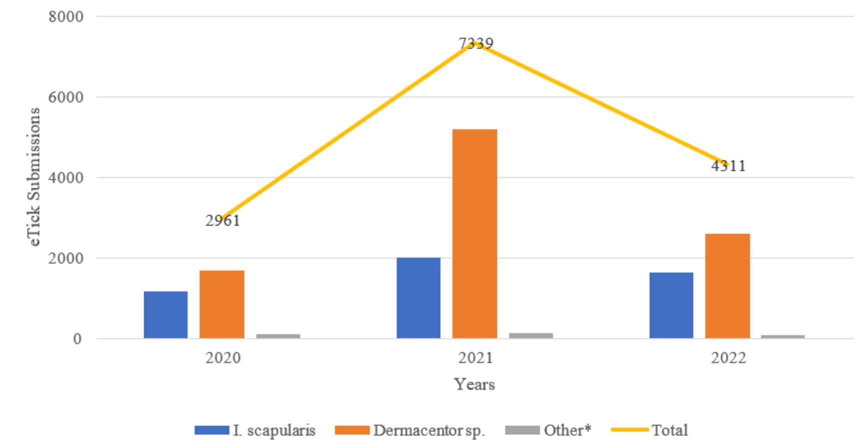

Figure 1: eTick Submission 2020 to 2022. eTick submissions from 2020 to 2022, excluding submissions with travel history. *The total number of species submissions excluding *I. scapularis, and Dermacentor sp.*

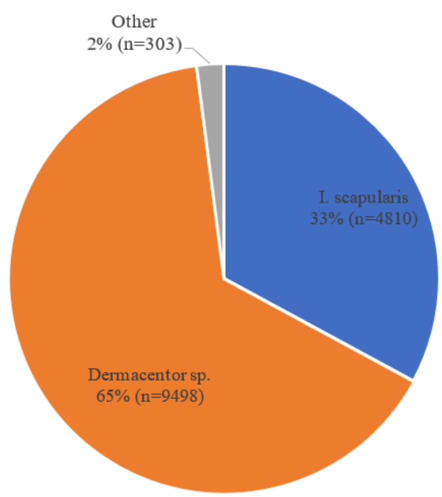

Figure 2: Total eTick Submissions from 2020 to 2022 (n = 14,611). Total eTick submissions between 2020 to 2022 found on humans, animals, and free in the environment, excluding travel history.

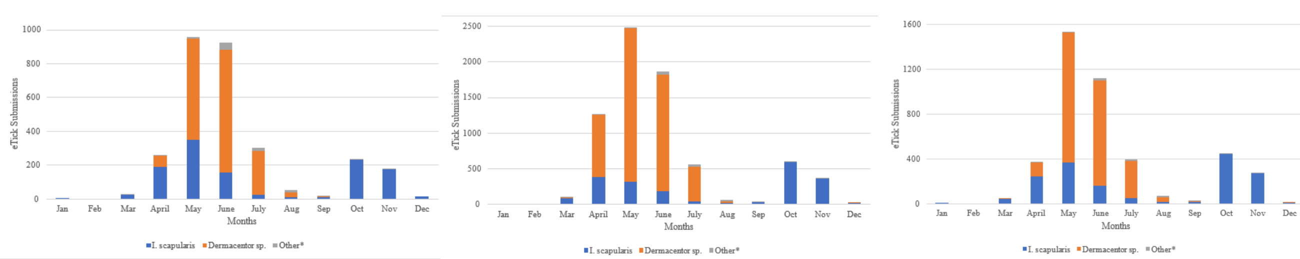

Figure 3: Monthly eTick Submission 2020, 2021, and 2022. Monthly eTick submissions for 2020, 2021, and 2022, excluding travel history. *The total number of species submissions excluding *I. scapularis, and Dermacentor sp.*

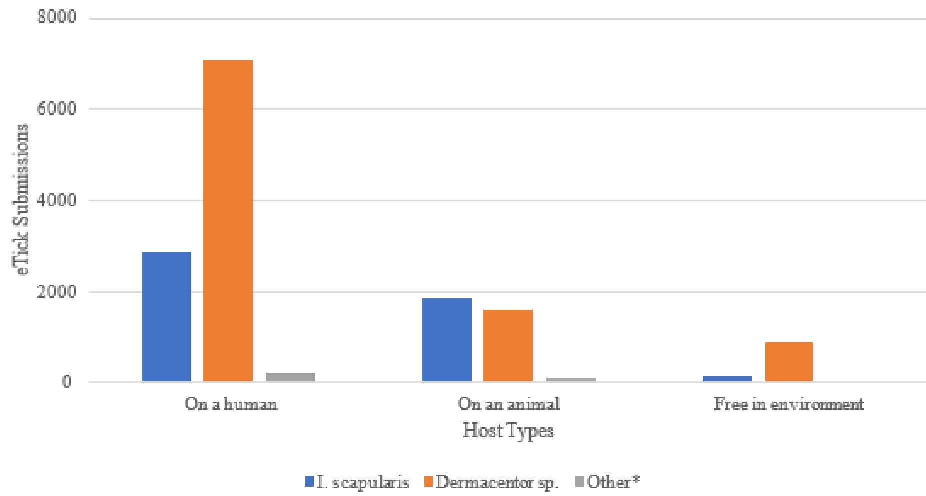

Figure 4: eTick Submissions Categroized by Host Types from 2020 to 2022. eTick submissions categorized by host types from 2020 to 2022, excluding submissions with travel history. *The total number of species submissions *excluding I. scapularis, and Dermacentor sp.*

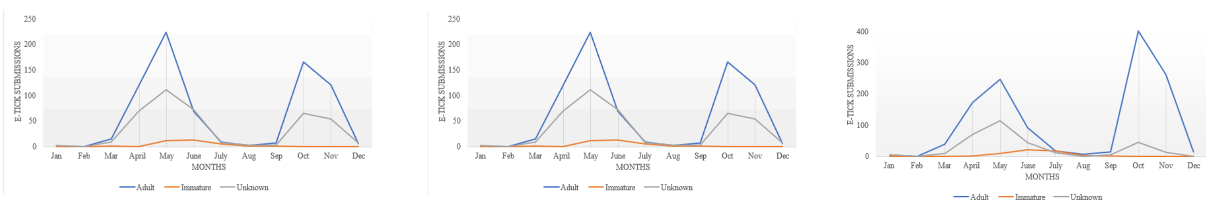

Figure 5: Monthly Submissions of *I. scapularis* by Life Stage in 2020, 2021, 2022. Monthly submissions of *Ixodes scapularis* categorized by life stage for 2020, 2021, 2022, excluding the travel history.

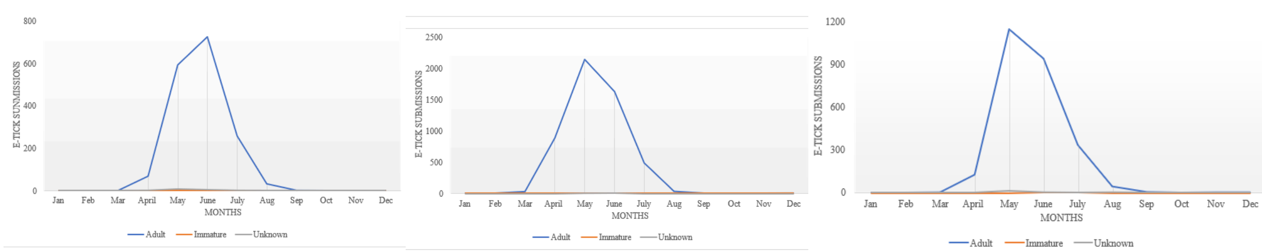

Figure 6: Monthly Submissions of *Dermacentor sp.* by Life Stage in 2020, 2021, and 2022. Monthly submissions of *Dermacentor sp.* categorized by life stage for 2020, 2021, 2022, excluding the travel history.

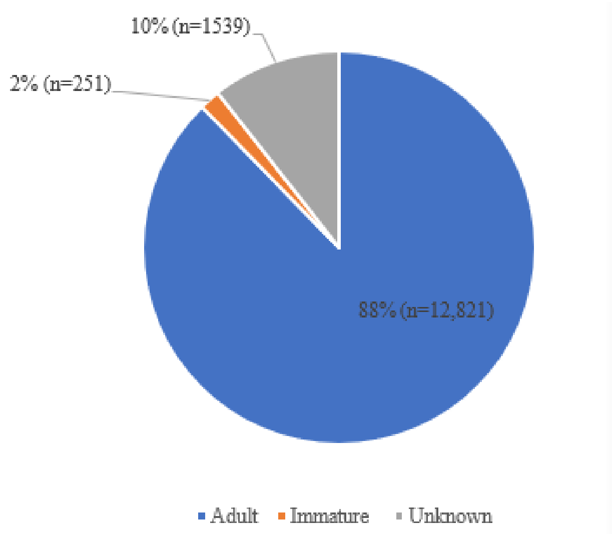

Figure 7: Total eTick Submission Categorized by Life Stage from 2020 to 2022. eTick submissions categorized by life stage from 2020 to 2022, excluding the travel history.

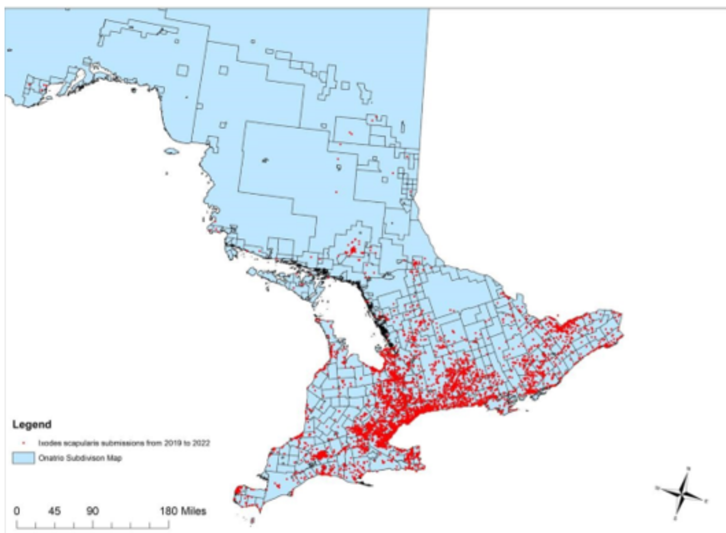

Figure 8: *Ixodes scapularis* Submission (n = 6,305) in Ontario from 2019 - 2022. *Ixodes scapularis* submissions in Ontario from 2019 to 2022 (n = 6,305)

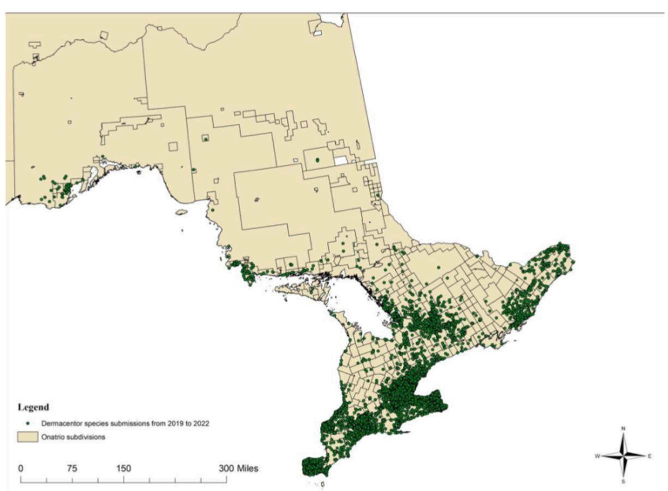

Figure 9: *Dermacentor species* submissions (n = 11,370) in Ontario from 2019 – 2022. *Dermacentor species* submissions in Ontario from 2019 to 2022 (n = 11,370)

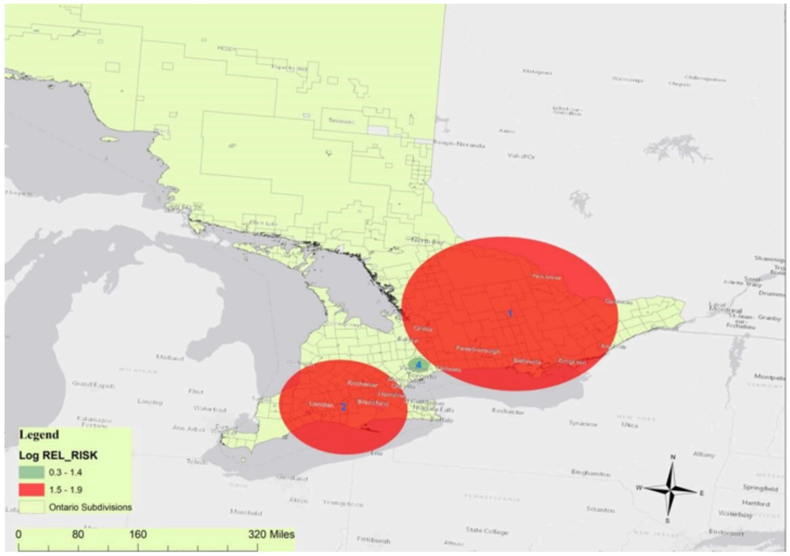

Figure 10: : *Ixodes scapularis* Submission (n = 2,440) in Ontario from 2021. Spatiotemporal clusters of I*xodes scapularis* submissions in Ontario in 2021 (n = 2,440).

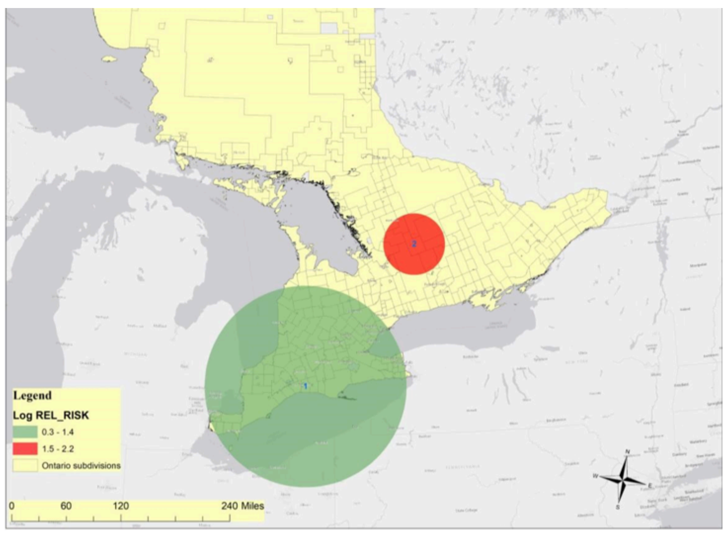

Figure 11: *Dermacentor* species Submissions (n = 5,975) in Ontario in 2021. Spatiotemporal clusters of *Dermacentor species* submissions in Ontario in 2021(n = 5,975).

Species	2020	2021	2022
I. scapularis	1173	2003	1634
Dermacentor sp.	1688	5203	2607
H. leporispalustris	1	0	0
I. cookei	72	92	38
I. marxi	8	11	4
A. americanum	11	19	16
R. sanguineus	4	2	3
A. maculatum	1	5	3
I. muris	3	4	3
H. chordeilis	0	0	3
I. kingi	0	0	0
Other*	100	133	70
Total	2961	7339	4311

Table 1: eTick Submissions 2020 – 2022. eTick Submissions 2020 to 2022, excluding travel history. *The total of species submissions excluding *I. scapularis, and Dermacentor* sp.

Species	On a human	On an animal	Free in environment
I. scapularis	2828	1846	136
Dermacentor sp.	7049	1568	881
H. leporispalustris	0	1	0
I. cookei	145	45	12
I. marxi	18	1	4
A. americanum	28	14	4
R. sanguineus	5	1	3
A. maculatum	6	2	1
I. muris	5	4	1
H. chordeilis	0	3	0
I. kingi	0	0	0
Other*	207	71	25
Total	10084	3485	1042

Table 2: eTick Submission Categorized by Host Types from 2020 – 2022. eTick submissions categorized by host types from 2020 to 2022. * The total of species submissions excluding *I.* 360 *scapularis, and Dermacentor sp.*

CLUSTER	RADIUS (KM)	START_DATE	END_DATE	OBSERVED	EXPECTED	Log_RR	REL_RISK	POPULATION
1	165.5	2021/6/1	2021/11/30	602	13.0	1.8	61.1	303283.8
2	101.7	2021/10/1	2021/11/30	312	4.3	1.9	83.8	302964.0
3	0.0	2021/10/1	2021/11/30	63	1.0	1.8	63.9	296475.3
4	16.6	2021/10/1	2021/11/30	50	1.9	1.4	26.5	118169.3

Table 3: Spatial Temporal Analysis of *Ixodes scapularis* in Ontario from 2021. Spatial Temporal Analysis of *Ixodes scapularis* Explaining the Relative Risk in Ontario from 2021.

CLUSTER	RADIUS (KM)	START DATE	END DATE	OBSERVED	EXPECTED	LOG RR	REL RISK	POPULATION
1	173	2021/4/1	2021/7/31	4656	857	1.3	21	32855.4
2	53	2021/4/1	2021/7/31	468	3	2.2	157	123.7

Table 4: Spatial Temporal Analysis of *Dermacentor species* in Ontario from 2021. Spatial Temporal Analysis of *Dermacentor species* Explaining the Relative Risk in Ontario from 2021.

Discussion

Climate change has driven an increase in tick populations across Ontario. As temperatures warm, species like *Ixodes scapularis*, which spreads Lyme disease, and other species like *Dermacentor variabilis*, which can spread Rocky Mountain spotted fever and tularemia, are increasing their range [2-3]. In our study, a wide variety of tick species have been identified through the eTick platform in the province of Ontario since 2019.

Ixodes scapularis, commonly known as the black-legged tick, is found throughout Central, Southern, and Eastern Ontario. The number of tick submissions tends to increase in May and October, indicating that these regions are at a higher risk of tick bites during peak periods. High-rate clusters of *I. scapularis* have been discovered throughout these regions, consistent with previous studies on the distribution o*f I. scapularis* and Lyme disease. A field sampling conducted by Clow et al. from May to October 2014 in Central, Eastern, and Southern Ontario detected B. burgdorferi-positive ticks, mainly clustered in Eastern Ontario [6].

Another field sampling study conducted between 2014 and 2015 suggested that the Lyme disease-carrying ticks spread across Ontario, especially in Eastern areas, at a rate of 46 km per year [7]. A suitable habitat allows *I. scapularis* populations to continue to expand. Slatculescu et al. conducted an active field sampling from 120 sites across Southern, Central and Eastern Ontario between 2015 and 2018 using niche modelling [8]. The study found that Eastern Ontario and some areas near the Great Lakes are highly suitable for Lyme disease carrying ticks due to factors such as elevation, distance to forests, proportions of agricultural land, and temperature [8].

On the other hand, *Dermacentor sp.* has received higher submissions than *I. scapularis* over the past three years. *Dermacentor sp.* is predominantly found in Southern and Central Ontario, with increased submissions around May, signalling a higher risk of tick bites during this peak period. Our finding is aligned with a study conducted between 2010 and 2018 in Ontario, which revealed that major tick submissions were located in Southern Ontario, including Brant County, Haldimand-Norfolk, Niagara Regional in the Central West region, and Lambton and Windsor-Essex County in the Southwest region [9]. *Dermacentor sp.* typically inhabits warm, low-lying areas with poorly drained soils [9]. Without a doubt, climate factors such as temperature play a crucial role in the distribution of these ticks. A study that used a correlative maximum entropy approach to predict current and future distribution suggested that *Dermacentor sp.* is likely to expand northward into Canada by 2050 due to climate change [10].

Strengths:
One of the key strengths of this research is the utilization of photo submissions as a method for data collection. This allowed us to observe the tick species, gender, and life stage. Another strength is the use of both ArcGIS and SaTScan as advanced retrospective space-time analysis methods. By integrating ArcGIS with the Kulldorff spatial scan technique, the study was able to effectively identify clusters with high submission rates. This led to the visualization of geographic locations, cluster sizes, and localized patterns in tick distribution across regions [11]. The findings from this study provide valuable insights into the spread of tick activity and have significant implications for public health interventions. Specifically, they can contribute to the development of targeted prevention and control strategies for tick-borne diseases, ultimately improving public health outcomes.

Limitations:
The use of photo submissions as data collection could be a potential limitation of this study, due to the fact that not all of the photos are clear. This may lead to mismatches, or to an inability to identify the species, which could ultimately impact the resulting distribution of ticks. Although efforts were made to adjust for population differences in spatial analysis, variations in human and animal population density within census subdivisions can introduce complexities and uncertainties to the findings. This highlights the need for careful interpretation of the results, with consideration of the study areas' demographics.

Another limitation of the study is the lack of information on human and animal behaviours that could impact tick sightings, such as outdoor activities and pet grooming practices. As a result, the interpretation of observed trends in tick distribution may be limited by the absence of behavioural data.

Future suggestion:
In order to effectively combat tick-borne diseases, it is crucial for researchers to combine pathogen surveillance with tick distribution studies. By doing so, they can better understand the risk of tick-borne diseases in high-risk areas. Researchers can identify clusters of high tick density and pathogen prevalence through this integrated approach, allowing for targeted public health interventions. By incorporating data on tick population dynamics, host preferences, and habitat distribution, researchers can also gain insight into the ecological factors contributing to tick-borne disease transmission. Ultimately, this information can help inform public health policies and interventions to reduce the incidence of tick-borne diseases and improve health outcomes for individuals and communities at risk.

Conclusion

Given the importance of *I. scapularis* as a vector of Lyme disease, and the emergence of new tick vector species and tick-borne diseases associated with climate change, it will be essential to monitor trends in tick distribution and diversity to inform public health and future research into the emergence and spread of tick-borne diseases [12].

Competing interests

The authors declare that they have no competing interests.

Acknowledgments

This work would not be possible without the funding support from the University of Ottawa Undergraduate Research Opportunity Program (UROP). We would like to thank Dr. Kulkarni's INSIGHT Lab, which is a partner on the eTick project as one of two regional expert hubs for Ontario, for their support. We would like to thank the eTick.ca project lead Dr. Jade Savage, and eTick.ca coordinator Jeremie Bouffard (Bishop's University) for sharing tick submission data from the eTick.ca project. We would also like to thank Dr. Katie Clow and Dr. Claire Jardine (University of Guelph) for their contributions to eTick.ca data collection in Ontario.

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Alzheimer’s Across Cultures: Examining the Impact of Indigenous Community Circumstances and Cultural Perspectives on Treatment.

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Abstract
An estimated 10,800 people of Indigenous ancestry in Canada live with dementia [1], for which the most predominant cause is Alzheimer’s disease [2]. While there are no known interventions that can cure Alzheimer's, both pharmacological and therapeutic treatments are widely employed [2]. While these treatment avenues have been widely implemented among the general Canadian population, there is a knowledge gap with regards to how the differing circumstances and cultural approaches of the Indigenous community impact how they interface with these treatments [3]. As such, the proposed study would investigate and summarize the existing literature on how these unique circumstances and cultural perspectives could impact access to care and influence the perception, diagnosis, and treatment of Alzheimer’s in Indigenous communities. Given the general higher susceptibility of Indigenous populations to Alzheimer’s due to a higher prevalence of modifiable risk factors [4], it is hypothesized that the unique circumstances and cultural perspectives of the Indigenous community will, similarly, reflect poorer treatment outcomes for Alzheimer’s in Indigenous populations than the general Canadian population. The methodology employed by this study would be a systematic review, serving as a general, but reproducible, outlook on the current state of research in this subject area and as a foundation for further research. The proposed study would serve to determine the best approaches to and need for implementing accessible and culturally-sensitive care for Alzheimer’s disease in Indigenous communities. The insights gained would allow for further understanding and integration of the underrepresented Indigenous perspective within the healthcare system.

Competing interests
The authors declare that they have no competing interests.

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Résumé
Au Canada, on estime qu'environ 10 800 Autochtones vivent avec la démence [1], dont la cause importante est la maladie d'Alzheimer [2]. Bien qu'il n'existe pas de remède pour cette maladie, il y a toutefois des traitements pharmacologiques et thérapeutiques qui sont largement disponibles pour ces patients [2]. Alors que ces avenues de traitement ont été largement mises en œuvre au sein de la population canadienne, il y a un manque de connaissance significatif concernant l'impact des perspectives culturelles autochtones et des circonstances spécifiques de leur communauté sur l'efficacité et l'accessibilité de ces traitements [3]. Ainsi, l'étude proposée va passer en revue et consolider la littérature existante afin d'examiner jusqu'à quelle point les circonstances uniques et perspectives culturelles des communautés autochtones pourraient avoir un impact sur l'accès aux soins et influencer la perception, le diagnostic et le traitement de la maladie d'Alzheimer dans ces communautés. Étant donné la susceptibilité générale plus élevée des populations autochtones à la maladie d'Alzheimer, en raison d'une prévalence plus élevée de facteurs de risque modifiables [4], on suppose que leurs circonstances culturelles et communautaires uniques sont corrélées à de moins bons résultats de traitement d'Alzheimer par rapport à la population canadienne générale. La méthodologie employée par cette étude serait une revue systématique, qui serait une perspective générale, mais reproductible, sur l'état actuel de la recherche dans ce domaine et comme base pour de futures recherches. L'étude proposée servirait à déterminer les meilleures approches et la nécessité de mettre en œuvre des soins accessibles et sensibles à la culture pour la maladie d'Alzheimer dans les communautés autochtones. Les connaissances acquises par cette étude peuvent permettre une meilleure compréhension et intégration de la perspective autochtone sous-représentée dans le système de santé canadien.

From an Alzheimer's Diagnosis to a Solution

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Abstract

Meet Mrs. Rodriguez, a 72 year-old retired school teacher, now living by herself, who was recently diagnosed with Alzheimer's Disease (AD). AD represents the cause of 60% to 80% of Dementias [7], a broad term that encompasses conditions describing symptoms associated with progressive deterioration of cognitive activity, and of which the prevalence increases over the age of 65 years old [12] [7].

Mrs. Rodriguez was always a bright and responsible woman. However, she recently found herself forgetting where her car was parked at the supermarket or losing her words during conversations. She made a visit to her doctor to discuss the issue. The physician firstly proceeded to run a Mini-Mental State examination (MMSE), a test conceptualized in 1975, and now available in several versions to accommodate patient's varying conditions [3]. The MMSE is taken in about 15 minutes and consists of questions to assess cognitive impairment [8]. Additionally, Mrs. Rodriguez was referred to have a FDG (2-[18F]fluoro-2-deoxy-D-glucose) - PET (positron emission tomography) scan. This brain imaging procedure reflects glucose metabolic rates in the cerebral regions [7]. Studies have shown that alterations in brain glucose metabolism precedes development of AD symptoms, and its distinct pattern allows differentiation from other prevalent forms of Dementia [9]. The results of the scan were sent to Mrs. Rodriguez's doctor within a few days and confirmed an Alzheimer's Disease diagnosis [14].

Now, while feeling her own fear and anger, the newly diagnosed patient gathers her close family members to inform them about her condition. Every family member takes the news differently, but most importantly, everyone is open to her needs and there for support [1].
The following concern consists of deciding what action course will be taken next. While there is no cure for Dementia, current treatments exist to help manage mood and behavior changes and maintain some cognitive abilities. Some non-drug therapies include social interaction and mental stimulation through activities and cognitive exercises. In terms of medications, 4 drugs are approved by Health Canada and available upon prescription to temporarily improve memory, time and space perception, communication, and performance ability: AriceptTM, ExelonTM , Reminyl ERTM, and Ebixa®. Some people might additionally benefit from general medication for other related conditions like psychosis, sleep disturbance, depression and strong emotional response behavior [13].

Setting apart medications, the main AD treatment initiative consists of giving personal assistance to the patient. While some people with various forms of Dementia including AD can live alone, there are several cognitive impairments that can become hazardous. As an example, they might experience a loss of orientation, posing of risk of getting lost during a trip to the grocery store or an outdoor walk. Additionally, it is possible that they can forget about basic housekeeping and hygiene tasks, like letting food spoil, or not brushing their teeth [2]. A caretaker can come on short regular visits to ensure proper maintenance of the patient's well-being and their property, as well as providing emotional support.

However, the process of being, or having a guardian adds another financial burden to family members, on top of medical economic demands. With all expenses, including potential hospital stays or emergency department visit, and direct costs of services such as prescription medicines and nursing, the average cost per patient with dementia in Ontario in 2020 was an estimated $60 000 [4]. This average also considers patients with severe Dementia who reside in a long-term care facility for which the monthly cost sits around $22,000 [10]. Considering that the average caretaker wage is $30 per hour, and the number of hours required each week ranges from 4.9 hours to 22.2 hours per week in accordance with the severity on symptoms, the yearly cost of a guardian can range from about $7, 600 to $34, 600 [6]. Mrs. Rodriguez's memory loss is still very mild.

Therefore, her family decides to hire a nurse who will come for an hour Monday through Friday. Then, family members would spend their own time with their relative on weekends. However, symptoms of Dementia are known to progress over a few years, creating greater destabilizing effects on patient's overall health and abilities [12]. Three years later, Mrs. Rodriguez's AD has progressed from mild to moderate, where symptoms include difficulty to organize thoughts and logical thinking, difficulty speaking, writing, or using numbers, forgetting its own history and other family members, restless nights and tiredness during the day, and inappropriate emotional outbursts.

From there, a patient's condition is prone to progress further, over a few years again, to a severe stage where the individual might experience a loss of ability to communicate, a loss of awareness of their surroundings, difficulty to swallow, known as aspiration pneumonia, a loss of appetite and a loss of bowel or bladder control or both [11].

With the increased difficulty of performing regular tasks associated with moderate to severe AD, constant surveillance and assistance becomes necessary for the patient. Mrs. Rodriguez is therefore moved to a long-term care home equipped for Memory Care, which comprises of staff equipped for full-day caregiving, and programs for social interaction and mental stimulation to help maintain patient's cognitive [5]. After such decision, Mrs. Rodriguez is known to be in good hands and can prolong and enjoy her last years as much as possible.

Résumé

Voici Mme Rodriguez, une enseignante retraitée de 72 ans, qui vit désormais seule et qui a récemment reçu un diagnostic de maladie d'Alzheimer (MA). La MA est à l'origine de 60 à 80 % des démences [7], un terme général qui englobe les affections décrivant des symptômes associés à une détérioration progressive de l'activité cognitive, et dont la prévalence augmente après 65 ans [12][7].

Mme Rodriguez a toujours été une femme brillante et responsable. Cependant, elle s'est récemment aperçue qu'elle oubliait où était stationnée sa voiture au supermarché ou qu'elle perdait ses mots au cours d'une conversation. Elle s'est rendue chez son médecin pour discuter de ce problème. Le médecin a tout d'abord procédé à un Mini-Mental State Examination (MMSE) [3], un test créé en 1975 et désormais disponible en plusieurs versions pour s'adapter aux conditions variables des patients. Le MMSE se déroule en approximativement 15 minutes, et consiste en des questions visant à évaluer la déficience cognitive [8]. D'ailleurs, Mme Rodriguez a été orientée vers un scanner FDG (2-[18F]fluoro-2-désoxy-D-glucose) - PET (tomographie par émission de positrons). Cette procédure d'imagerie cérébrale reflète les taux métaboliques de glucose dans les régions cérébrales [7]. Des études ont démontré que les altérations du métabolisme du glucose dans le cerveau précèdent l'apparition des symptômes de la MA, et que leur profil distinct permet de les différencier des autres formes prévalentes de démence [9]. Les résultats du scanner ont été envoyés au médecin de Mme Rodriguez quelques jours plus tard et ont confirmé le diagnostic de la maladie d'Alzheimer [14].

Maintenant, tout en ressentant sa propre peur et sa propre colère, la patiente nouvellement diagnostiquée rassemble les membres de sa famille proche pour les informer de son état. Chaque membre de la famille prend la nouvelle différemment, mais le plus important, c'est que tous sont ouverts à ses besoins et lui apportent leur soutien [1]. La préoccupation suivante consiste à décider de la marche à suivre. Bien qu'il n'y ait pas de remède à la démence, il existe actuellement des traitements qui aident à gérer les changements d'humeur et de comportement, et à maintenir certaines capacités cognitives. Certaines thérapies non médicamenteuses incluent l'interaction sociale et la stimulation mentale par le biais d'activités et d'exercices cognitifs.

En ce qui concerne les médicaments, quatre médicaments sont approuvés par Santé Canada et disponibles sur ordonnance pour améliorer temporairement la mémoire, la perception du temps et de l'espace, la communication et la capacité de performance : AriceptTM, ExelonTM, Reminyl ERTM et Ebixa®. Certaines personnes peuvent également bénéficier d'une médication générale pour d'autres troubles connexes, tels que la psychose, les troubles du sommeil, la dépression et les réactions émotionnelles fortes [13].

En dehors des médicaments, la principale initiative de traitement de la MA consiste à apporter une assistance personnelle au patient. Bien que certaines personnes atteintes de diverses formes de démence, y compris la MA, puissent vivre seules, plusieurs déficiences cognitives peuvent devenir dangereuses. Par exemple, elles peuvent perdre le sens de l'orientation, ce qui les expose au risque de se perdre lors d'une visite à l'épicerie ou d'une promenade en plein air. De plus, il est possible qu'elles oublient les tâches ménagères et d'hygiène de base, comme laisser les aliments pourrir ou ne pas se brosser les dents [2]. Un soignant peut effectuer de courtes visites régulières pour veiller au bon maintien du bien-être du patient et de ses biens, ainsi que pour lui apporter un soutien émotionnel.

Cependant, le fait d'être ou d'avoir un aidant ajoute une autre charge financière aux membres de la famille, en plus des exigences économiques médicales. En tenant compte de toutes les dépenses, y compris les éventuels séjours à l'hôpital ou les visites aux urgences, et des coûts directs des services tels que les médicaments sur ordonnance et les soins infirmiers, le coût moyen par patient atteint de démence en Ontario en 2020 était estimé à 60 000 dollars [4]. Cette moyenne tient également compte des patients atteints de démence grave qui résident dans un établissement de soins de longue durée, pour lesquels le coût mensuel s'élève à environ 22 000 $ [10]. Si l'on considère que le salaire moyen d'un soignant est de 30 dollars de l'heure et que le nombre d'heures requises chaque semaine varie de 4,9 heures à 22,2 heures, selon la gravité des symptômes, le coût annuel d'un tuteur peut varier de 7 600 à 34 600 dollars [6]. Les pertes de mémoire de Mme Rodriguez sont encore très légères. Sa famille décide donc d'engager une infirmière qui viendra une heure, du lundi au vendredi. Les membres de la famille pourront alors passer du temps avec leur proche les fins de semaine.

Cependant, on sait que les symptômes de la démence progressent sur plusieurs années, créant des effets plus déstabilisants sur la santé et les capacités générales du patient [12]. Trois ans plus tard, la maladie d'Alzheimer de Mme Rodriguez est passée de légère à modérée, avec les symptômes suivants : difficulté à organiser ses pensées et à penser logiquement, difficulté à parler, à écrire ou à utiliser des chiffres, oubli de sa propre histoire et des autres membres de la famille, nuits agitées et fatigue pendant la journée, et crises émotionnelles inappropriées.

À partir de là, l'état d'un patient est susceptible d'évoluer, sur quelques années encore, vers un stade sévère, où l'individu peut éprouver une perte de capacité à communiquer, une perte de conscience de son environnement, une difficulté à avaler, connue sous le nom de pneumonie d'aspiration, une perte d'appétit et une perte de contrôle de l'intestin/la vessie, ou des deux à la fois [11].

En raison de la difficulté accrue à accomplir des tâches régulières, associée à la MA modérée à sévère, une surveillance et une assistance constantes deviennent nécessaires pour le patient. Mme Rodriguez est donc transférée dans une maison de soins de longue durée équipée pour les soins de la mémoire, qui comprend du personnel équipé pour des soins à temps plein, et des programmes d'interaction sociale et de stimulation mentale pour aider à maintenir les capacités cognitives du patient [5]. Après une telle décision, Mme Rodriguez est entre de bonnes mains et peut prolonger et profiter autant que possible de ses dernières années de vie.

Competing interests

The authors declare that they have no competing interests.

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Antibiotic Resistance- The Silent Pandemic

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Introduction

In 1928, Dr. Alexander Fleming made a groundbreaking discovery upon returning from a vacation to find that a mold, later identified as Penicillium notatum, had contaminated a petri dish and was inhibiting the growth of the bacteria around it [1]. This accidental observation led to the cultivation of the mold and the realization of its extraordinary antibiotic properties, marking the discovery of penicillin [1]. This event ushered in the golden era of antibiotics, which revolutionized the treatment of diseases. In his 1945 Nobel Prize acceptance speech, Alexander Fleming cautioned about the potential for antibiotic misuse to lead to resistance [2]. His foresight was confirmed when, by 1948, the first cases of penicillin resistance were documented [2]. Antimicrobial medications have since become essential in both common and complex medical interventions, ranging from treating common illnesses to enabling major surgeries such as organ transplants, to chemotherapy [3]. Beyond human medicine, antibiotics have been utilized extensively in both animal husbandry and production. However, the combination of antibiotic misuse, slow development of new antibiotics, and escalation of antibiotic resistance poses a significant threat to global healthcare.

Rise of Antimicrobial Resistance

At times, a bacteria's normal characteristics result in immunity to certain antibiotic mechanisms of effect. This is known as intrinsic resistance and is not affected by misuse of antibiotics [2]. In contrast, some bacteria may acquire resistance to an antibiotic either by evolving a new characteristic through gene mutation, or by the transfer of genetic information amongst bacterial species [2]. Mutations may enable bacteria to produce enzymes or inactivate antibiotics through hydrolysis of the antibiotic or by adding a chemical group to the drug [4]. A common example of enzymatic activation is by the β-lactamase, which is produced by bacteria and inactivates penicillin [4]. Furthermore, mutations may alter the cell target that antibiotics attack or reduce permeability to antibiotics via downregulation of porins [4]. Other ways include the ablation of efflux pumps that export antibiotics outside the bacteria [2].

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In contrast, some bacteria may acquire resistance to an antibiotic either by evolving a new characteristic through gene mutation, or by the transfer of genetic information amongst bacterial species [2]. Mutations may enable bacteria to produce enzymes or inactivate antibiotics through hydrolysis of the antibiotic or by adding a chemical group to the drug [4]. A common example of enzymatic activation is by the β-lactamase, which is produced by bacteria and inactivates penicillin [4]. Furthermore, mutations may alter the cell target that antibiotics attack or reduce permeability to antibiotics via downregulation of porins [4]. Other ways include the ablation of efflux pumps that export antibiotics outside the bacteria [2]. The Darwinian selective pressure that kills susceptible bacteria and allows resistant bacteria to thrive leads to multidrug-resistant bacteria, also known as superbugs [4]. Antibiotics remove drug sensitive competitors leaving resistant bacteria behind to reproduce as a result of natural selection. Of greater concern is the advanced gene transfer systems that enable bacteria to share genetic information between bacteria. Horizontal gene transfer (HGT) allows antibiotic resistance mechanisms to be transferred across species and to spread [2].

While antibiotic resistance is a natural process, the overuse and misuse of antibiotics has accelerated the speed at which resistance mechanisms form. According to an analysis of the IMS Health Midas database which estimates antibiotic consumption based on volume of antibiotics sold, approximately 22 doses of antibiotics were prescribed per person in the United States of America in 2010 [4]. Aside from overprescription, overuse is another leading factor that worsens antibacterial resistance heavily. A survey by the World Health Organization (WHO) highlighted that many people use antibiotics for the wrong reasons [6]. More than 30% of respondents reported using antibiotics for illnesses that do not require them [6]. Furthermore, 43% thought that antibiotics were effective against viruses [6]. The results of antibiotic overuse and overprescription have been deadly. In the European Union, approximately 25,000 patients die every year from infections caused by multi-resistant bacteria [7]. Given the current trend, it is predicted that the death will grow up to 390,000 by the year 2050 [8]. This rate is estimated to cause 10 million extra deaths worldwide by 2050 [8]. Reduction in population impacts the economic security of countries. This global threat is estimated to reduce the world Gross Domestic Product by 100 trillion USD by 2050 [8].

Looking Forward

As we navigate the complexities of antibiotic resistance, the interconnection between the roles of individuals, healthcare professionals, and policymakers becomes increasingly critical. Everyone has a part to play in this silent pandemic. Patients need to adhere strictly to prescribed antibiotic regimens and not share or reuse antibiotic medication. Healthcare providers and hospitals must prioritize infection control, rigorously apply antibiotic stewardship programs, and educate patients about the judicious use of antibiotics. Policy should aim to enhance surveillance of antibiotic use and resistance, regulate, and monitor the prescription of antibiotics, and invest in public health initiatives, to steer us towards a sustainable path. Moreover, fostering innovation and supporting the research and development of new treatments and antibiotics are critical steps toward outpacing the rapid evolution of resistant bacteria.

The recommendations from WHO stand as a clear and urgent call to action; however, these guidelines are just the starting point. Innovative approaches, such as the development of bacteriophage therapy and novel antibiotic treatments are on the horizon [9]. These advancements paired with shared antibiotic responsibility could provide substantial aid in this crisis. The clock is ticking; without meaningful action, the toll of antibiotic-resistant infections will continue to climb, undermining decades of medical progress and threatening the very foundations of modern healthcare.

Competing interests
The author declare that they have no competing interests.

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