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Enhancing accessibility and equity in utilization of virtual care: Virtual Care @ Your Library pilot project

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Abstract

Background The post-pandemic expansion of virtual care in Nova Scotia aimed to improve access for patients without primary care providers. Virtual Care Nova Scotia, launched in 2021, and increased access, but equitable reach remained a concern. The Virtual Care @ Your Library (VC@YL) initiative addressed this gap by offering virtual healthcare access through public libraries in collaboration with government and health organizations.

Methods This descriptive observational study applied the RE-AIM framework. Reach was assessed by the number of participants. Effectiveness was evaluated through service utilization and satisfaction. Adoption examined staff burden and role integration. Implementation fidelity and access barriers were documented. Maintenance was assessed via cost analysis and potential savings from avoiding emergency department (ED) and walk-in clinic visits under different utilization and cost scenarios.

Results VC@YL engaged 518 unique users across 1,073 visits. Most users were aged 65+ (64.2%), citing technological barriers (75.4%) and support needs (77.6%) as primary reasons for use. All users successfully completed virtual care appointments, with 98% reporting positive experiences. Among library staff, 83% felt well-supported, and 65% of patron interactions required less than 15 min. Digital literacy assistance was the most common service (75.4%).

The total project cost for VC@YL was $93,061, incorporating both one-time implementation and recurring staff costs. The cost per VC@YL utilization was $87. Avoided ED visits resulted in net savings of up to $63,614, though higher virtual care costs reduced savings in certain scenarios. Walk-in clinic diversions yielded negative cost savings due to the cost structure. Total savings ranged from $15,708 to $61,541, with per-person savings from $30 to $57, depending on virtual care consultation costs and utilization levels.

Conclusions The VC@YL initiative demonstrated how community-based programs can effectively enhance access to virtual care, particularly for individuals facing technological barriers. This pilot project showed strong potential for improving healthcare access through practical support and leveraging existing community infrastructure. Its scalability and cost-effectiveness make it a promising model for broader implementation in similar settings.

Keywords Virtual care, Library, Public health, Telehealth, Innovation, Community

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Background

During the pandemic, virtual care rapidly expanded in most care systems across Canada. While it was initially introduced to reduce the spread of COVID-19, many jurisdictions are expanding or maintaining virtual care programs because they may offer benefits beyond the pandemic, including improving Canadians' access to care and reducing costs for health systems and patients [1, 2]. The potential benefits and unintended consequences of virtual care within the Canadian healthcare systems are an active area of research to help inform future investments and approaches to delivering healthcare services virtually [1]. The equitability of virtual care programs is a key consideration while planning for integration of these programs, with the World Health Organization cautioning that "the deployment of digital technologies can widen the digital divide, leaving behind those without digital devices or skills" [3].

Nova Scotia Health (NSH) Virtual Care Services defines virtual care as "Any remote interaction between patients and their circle of care using approved communication or technologies." These interactions aim to facilitate or maximize the quality and effectiveness of patient care. For example, it has been deemed appropriate for presenting complaints that require only an oral history, a general inspection, or items that a patient can show a practitioner through a camera (e.g., mental health concerns, skin conditions and minor infections) [4, 5].

Virtual Care Nova Scotia (VCNS) is a virtual primary care service launched in May 2021 to enhance access to care for patients without a primary care provider. In the context of VCNS, virtual care refers to real-time, synchronous phone or video-based consultations conducted via the Maple platform, a digital platform designed for healthcare delivery. VCNS leverages the Maple platform to provide two tiers of care: full care, which is accessible only to individuals without a primary care provider, offering comprehensive services, including video consultations, prescriptions, test ordering, and specialist referrals; and basic care, available to all Nova Scotians, offering general healthcare advice and prescription renewals (excluding controlled substances). While primarily video-based, this care can accommodate telephone support in specific cases when video is not feasible. Both services aim to reduce barriers to healthcare, particularly for populations without regular access to primary care. VCNS does not currently include asynchronous services like secure messaging or email. Telephone-based consultations are not a primary mode of service delivery but may be used to address accessibility issues for patients unable to connect via video. Physical examinations and the management of controlled substances are outside the program's scope.

One of the key considerations when implementing this program was to ensure access equity. Virtual care assumes broadband is readily available, the necessary up-to-date technology device is on hand, and the person has a safe space to attend their care appointment and the required literacy levels, skills, and cognitive abilities to engage with the applications. Lack of digital literacy or familiarity with such devices are known barriers to accessing virtual care [6]. Digital literacy issues are known to be more prominent among certain demographic and socioeconomic groups, particularly older adults [7].

Libraries have been identified as situated to potentially address virtual care's equity challenges [8]. Public libraries offer publicly available internet access, librarians are highly trained in information access skills, which can bridge the digital inclusion gap, and many already play an important role in community health literacy [8–10]. However, it has been highlighted that very little guidance is available regarding implementing virtual care assistance programs in libraries, making it challenging for organizations to know where to start [11]. Implementing health services in a library setting can have many logistical and regulatory challenges (e.g., space, training, privacy, accessibility, funding, working across the health and community institutions, etc.).

The study aims to evaluate the implementation and effectiveness of the Virtual Care @ Your Library (VC@ YL) pilot project, a complementary initiative to a virtual care service designed to improve access to virtual healthcare by addressing barriers such as digital literacy, technology access, and internet connectivity. It seeks to assess the project's success in enhancing accessibility, overcoming obstacles, and facilitating virtual care delivery. Additionally, the study examines the project's adoption, user demographics, satisfaction, and cost-effectiveness, providing valuable insights to inform the implementation of similar initiatives in other settings.

Context and setting

NSH introduced VCNS in May 2021 as a solution to primary care access for the growing number of unattached patients in the province. As of 2022, the proportion of attached persons in Nova Scotia was 85.2% (734 200), based on responses to the Statistics Canada Canadian Community Health Survey [12]. This aligns with the number of persons registered on Nova Scotia's Need a Family Practice Registry (NFPR) (approximately 15% of the Nova Scotian population) [13]. In December 2017, approximately 42,198 individuals (4.5% of the population) were on the registry, which rose to 59,225 (6.5%) by early 2019. After a brief decline to 46,914 (5.1%) in 2020, the numbers began to rise significantly [13]. VCNS was designed to provide interim access to primary care for

persons on the NFPR while they waited to be attached to a primary care provider. In addition to virtual and in-person primary care access, the service provided access to other healthcare pathways (e.g., labs, diagnostics, and specialist referrals). Access to VCNS was rolled out across the province between May 2021 and April 2022. Persons on the NFPR were emailed an invitation to enroll in VCNS services. The enrolment process included registering and creating an account on the VCNS platform. Given that this process required significant digital literacy skills, there were concerns regarding equity in access. The Virtual Care @ Your Library (VC@YL) pilot project was designed to provide a community-based service to help users overcome barriers to accessing and engaging with the VCNS platform to receive primary care. However, it was not limited to assisting with VCNS, as people also utilized the service to attend virtual appointments with specialists (Zoom for healthcare), register for the NFPR, book online lab and diagnostics and even set up emails to access virtual services in the future.

Implementation considerations: program setup and resources

VC@YL was a 1-year pilot project launched in February 2022 as a joint initiative between the libraries (Pictou Antigonish Regional Libraries; PARL), the Nova Scotia Government, NSH, and the Aberdeen Health Foundation, a charitable foundation committed to enhancing healthcare in Pictou County, Nova Scotia. The pre-implementation phase involved the formation of a steering committee, hiring a library technician, training library staff, and outreach and promotion. The project steering committee developed the project charter and evaluation plan, and a comprehensive implementation plan that involved key partners across the province. Major partners included the Aberdeen Health Foundation, PARL, and NSH.

The resource requirements included a technician, a NSH technology trainer, travel expenses, technology needs (laptop, tablet/mobile device), staff training, communication and promotion, and site improvements, including the separation for a private meeting space (adding additional room/capacity), ventilation improvements, and the provision of three accessible workstations. In addition, all the participating PARL libraries had private rooms available for private appointments, and the sites were modified to accommodate the needed equipment. Table 4 in the economic analysis contains additional details.

Library technician

A technician was hired to coordinate and run the initiative at the three library branches. The technician's primary role was to engage with library patrons directly and assist with needs related to accessing and engaging with virtual care, to train and engage other library staff to assist patrons, outreach and promotion of the initiative, and data collection for the evaluation of the initiative. Elements related to accessing and engaging with VCNS included assisting patrons with the registry for the NFPR, receiving VCNS invitations, VCNS registration and account setup, managing on-demand waiting room appointments, and ensuring a secure space for scheduled virtual care appointments. See Supplementary file 1 for role details.

Library technician and staff training

NSH Information Management/Information Technology (IM/IT) for Virtual Care Services was responsible for training the library technician and staff to carry out the program. The training included sessions focusing on virtual care platform-specific skills and resources (platforms such as Maple, Zoom for Healthcare, NAFP registry and lab and, diagnostic imaging booking etc.). Participants were also educated on infection control methods relevant to virtual care and received training on health privacy and security, including staff confidentiality agreements. Additionally, staff were provided with checklists aligned with Canadian healthcare accreditation standards to support virtual appointments effectively. Finally, materials were shared with the technician to enable ongoing library staff training using a train-the-trainer approach. Additional details are available in Supplementary file 2.

Outreach and promotion

Over 10,000 people in Pictou County on the NFPR were emailed in early February 2022 to inform them of the pilot project to promote the program. A media release was issued, Facebook posts were made on the NSH page, and ads were printed in local newspapers. Additionally, posters, banners and rack cards were developed for display at the three participating libraries and sent to local businesses such as community pharmacies. To engage providers, memos were sent to all Pictou County primary care providers, physicians, nurse practitioners, and Pictou County Nova Scotia Health Primary Care staff to inform them about the pilot project. The technician attended public events to promote the program. The project was also promoted within the NSH through e-newsletters and emails to primary care providers and NSH staff. The Aberdeen Health Foundation also promoted the pilot to its network through social media and distributed a notice that went to every household and business in Pictou County as part of its Report to Community (or Annual General Meeting Notice).

Methods

Study design

This was a descriptive observational study. We followed the Standards for Reporting Implementation Studies (StaRI) and Proctor et al.'s recommendations for specifying and reporting implementation strategies [14, 15]. The RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) evaluation framework guided the project evaluation [16]. The RE-AIM framework emphasizes reporting on the generalizability of the intervention context, implementation personnel and conditions, and other impacts at an individual and organizational level. This approach allows for a more nuanced and transparent understanding of the intervention and its consequences (both intended and unintended). It is particularly helpful when the goal is to scale the program. RE-AIM assesses an intervention through five domains: Reach, Effectiveness/Efficacy, Adoption, Implementation and Maintenance [16]. A recent systematic review identified the lack of information around the implementation process as a major impediment to the adoption of telemedicine in public libraries and recommended RE-AIM for future evaluations of digital health initiatives at libraries [11]. The main evaluation period was from March 1, 2022, until March 2023. We continued to monitor some outcomes after the initial evaluation period, and for those, we present data up until January 15, 2024.

The evaluation of the program aimed to describe the implementation of the VC@YL initiative in detail and assess the program's effectiveness in meeting its objectives. It aims to identify the factors that hindered or supported the achievement of those objectives, as well as examine the level of adoption of the program and the demographics of the population utilizing the services. The specific aims of the evaluation are described below:

1. To describe the program and its implementation: This aim focuses on providing a comprehensive account of the strategic approach, infrastructure setup, staff training, outreach efforts, and overall implementation process of the Virtual Care @ Your Library (VC@YL) initiative.
2. To describe the users, providers, and their experiences with VC@YL: This aim seeks to explore the demographic profiles, experiences, and barriers faced by the population utilizing the service.
3. To describe the outcomes of VC@YL: This aim evaluates the program's reach, effectiveness, and sustainability. It includes an analysis of economic outcomes such as cost avoidance and return on investment, along with an assessment of user satisfaction. It also seeks to identify how the program addressed barriers to accessing virtual care.

Outcomes

The project outcomes follow the RE-AIM's five dimensions. Regarding the project's reach into the target population, the total number of individuals invited to participate was the outcome. Since the main objective of the project was to facilitate access to virtual care in Nova Scotia, we assessed effectiveness using the number of beneficiaries, defined as the number of individuals whom the technician assisted in accessing virtual care services relative to the total number of individuals invited to participate in the project, stratified into those who successfully obtained virtual care appointments and those who did not after an encounter with the technician. We also assessed the effectiveness of the project using patron and library staff satisfaction ratings from surveys. Barriers to access and fidelity to the initial implementation plan were also documented through steering committee meetings. We assessed the maintenance of the project by quantifying the implementation costs, disaggregated by one-time and ongoing costs, and the potential cost savings associated with using the services provided through the project instead of visiting the emergency department (ED) or walk-in clinics.

Target population and sites

The VC@YL pilot project was set up at three library branches in the Pictou region of Nova Scotia (PARL). The program selected these sites because PARL staff, who were themselves individuals on the NFPR, identified digital literacy barriers for local citizens. These sites were also selected because they had private rooms, were accessible, and could support the project's main deliverables. The original target population was all individuals on the NFPR in Pictou County, Nova Scotia, who needed assistance accessing and engaging with the VCNS platform. It is estimated that as of 2021, the population of Pictou County was just under 45,000 residents, and approximately 24% of them were not attached to a primary care provider [13]. PARL submitted a grant for staffing and contacted the local Aberdeen Health Foundation for additional funding, project support, and assistance in linking with virtual care specialists in NSH.

Data collection

Utilization

The virtual care technician tracked the number of patrons who contacted the library about the service, used the service, and repeat users using a protected spreadsheet. This data was updated multiple times per day and was only accessible to the technicians. The data collection period for utilization was March 1, 2022, to January 15, 2024.

Patron and library staff surveys

The surveys utilized in this study were purposefully developed to evaluate the VC@YL initiative, ensuring alignment with the objectives and the RE-AIM framework. They were designed collaboratively, incorporating insights from the evaluation team, and project stakeholders to capture contextually relevant data. The design process included pilot testing to refine the items for face validity. Two custom surveys were created for this research: one for library staff and another for patrons. The survey instruments are in the supplementary materials (see Supplementary files 3 (Patron) and 4 (Staff)). The patron survey aimed to evaluate patron experience, identify barriers and facilitators to implementation, and assess the impact of the VC@YL initiative on the equity and accessibility of virtual care. It collected data on the type of virtual care service used, the number of times a patron used the service, their experience using the service and virtual care technology, the primary reason for using the service, suggestions for improvement, alternative care options without the service, and demographics.

The library staff survey gathered information on their experience delivering the program, readiness to deliver the program, average time spent assisting patrons, feedback from patrons, methods of assistance provided to patrons, challenges faced, and areas for improvement.

Surveys were offered to patrons immediately following their VC@YL encounter to gather timely feedback on their experiences and perceptions of the service. Staff surveys were administered approximately three months after the implementation. Survey data were collected and managed using REDCap (Research Electronic Data Capture), an electronic data capture tool hosted at NSH [17]. The technician also made paper versions of the surveys available to patrons and entered patron responses into REDCap. Recruitment for the survey was ongoing from program implementation (March 1, 2022) until January 15, 2024. Patrons were prompted to complete a survey after using the VC@YL services.

Economic data

Data for the economic analysis came from multiple sources, including surveys, NSH fees data, and the Canadian Institute for Health Information (CIHI). The cost per ED visit came from CIHI. The cost per walk-in-clinic visit was estimated using the Nova Scotia walk-in clinic fee for 2022. Costs associated with the implementation included costs associated with hiring a virtual care technician, communications and promotion, site improvements, and site accessibility. See Supplementary file 5 for the economic analysis related data. Costs associated with the steering committee work or NSH staff participation

were not assessed, this work was given in kind by each organization participating in the project.

Analysis

Program analysis

Basic descriptive statistics were used to summarize most of the survey data (primarily frequencies and proportions). To understand how survey respondents might differ from the eligible population, we compared survey respondents' age and sex to persons on the NFPR who reside in the Pictou area (roughly the catchment area of the libraries). It is worth noting that the invitations were staggered and based on a person's time on the registry; however, as of August 31, 2022, all registered persons are eligible for the program. We use the NFPR demographics as of July 1, 2022, as the comparison. We stratified survey responses by first-time users and repeat users to further understand if there were differences in the challenges experienced and supports needed. Stratification was based on responses to the question, "How many times have you used the service?" However, because survey responses are not linked across multiple surveys, we cannot distinguish between first-time responses from users who later became repeat users and those from individuals who only used the service once.

Economic analysis

The economic analysis employed a cost-benefit analysis (CBA) framework to assess the economic implications of implementing VC@YL compared to a do-nothing baseline, adhering to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) guidelines [18]. The time horizon for the analysis was approximately two years, so relevant costs and benefits were discounted at 3%. All monetary values were expressed in 2022 Canadian dollars. The analysis was conducted from a health system perspective, considering direct costs and savings relevant to a publicly funded healthcare system.

Comparators and scenarios The study examined four scenarios based on service utilization and VCNS consultation costs. Regarding VCNS costs per consultation, we utilized $69 per consult (based on publicly available data from the platform's vendor) and $122, which came from our internal estimate from a VCNS project. The vendor's advertised rate ($69) served as an external benchmark, while the internally derived cost ($122) accounted for organization-specific costs. This approach facilitated sensitivity analysis, scenario planning, and risk mitigation by capturing potential cost variability. The utilization varied depending on whether we included the number of unique individuals using VC@YL or the total number of interactions. These scenarios allowed for an assessment of both cost variability and economies of scale:

i.   Reference Case (*N* = 518)—This was a baseline scenario, assuming the overall utilization consisted of 518 unique individuals. The cost per VCNS consultation was set at $69 per visit.

ii. Scenario 1 (*N* = 518, Higher VCNS cost) – Identical to the reference case, except the cost per VCNS consultation increased to $122.

iii. Scenario 2 (*N* = 1,073, Increased utilization) – The number of VC@YL utilization increased to 1,073, the total number of interactions, while maintaining the VCNS consultation cost at $69 per consult. This scenario assessed whether higher utilization improves cost-effectiveness by distributing fixed costs over more visits.

iv. Scenario 3 (*N* = 1,073, Higher utilization and higher VCNS cost) – A combined scenario where both utilization increased to 1,073 visits, and VCNS consultation cost increased to $122 per visit.

Cost avoidance and savings The sources of potential cost avoidance included ED and walk-in clinic diversions. Participants in the program were asked: "If you had not used the virtual care services provided to you today, where would you have sought care?" Responses were used to estimate the proportions of ED and walk-in clinic visits avoided. The diversion rates remained constant across all scenarios. The proportions were then applied to the relevant measure of utilization to estimate the total number of avoided visits. Avoided visits were multiplied by unit costs to calculate cost avoidance. Unit costs for ED visits were sourced from Canadian Institute for Health Information (CIHI), while walk-in clinic costs were proxied using the 2022 Nova Scotia clinic fee.

The economic analysis computed the cost per VC@YL visit, net savings per avoided ED visit, net savings per avoided walk-in clinic visit, total savings calculated as the sum of savings from avoided ED and walk-in clinic visits, and savings per person computed by dividing total savings by the number of users in each scenario.

To compute the cost per VC@YL consult, we first calculated the total cost of the VC@YL program. We then divided this total cost by the number of VC@YL interactions to account for some users' multiple visits. By distributing the total program cost across these 1,073 interactions, the cost per consult remained consistent across all scenarios.

The net savings per avoided ED visit were calculated by taking the unit cost of an ED visit and subtracting the combined per-consult VC@YL and VCNS costs. Essentially, this represents how much the health system saves each time a patient avoids an ED visit by using VCNS through VC@YL instead. Similarly, the net saving per avoided walk-in clinic visit was determined by taking the estimated cost of a walk-in clinic visit (using the 2022

Nova Scotia clinic fee, including physician fees) and subtracting the combined per-consult VC@YL and VCNS costs.

To calculate total savings, we applied the respective ED and walk-in clinic diversion rates (based on participant survey responses) to the total number of VC@YL utilization in each scenario. We then summed the resulting savings from avoided ED and walk-in clinic visits. This figure captures the overall savings achieved by diverting patients from these in-person services. To derive savings per person, we divided the total savings by the number of utilizations in each scenario to determine the average savings for each person who used VC@YL.

Sensitivity analysis We employed a scenario-based (one-way) sensitivity analysis rather than a full probabilistic approach to account for potential variability in key parameters. Specifically, three distinct scenarios were defined (see above), in addition to the reference case, to reflect plausible ranges in both the number of VC@YL utilization (518 unique individuals versus 1,073 total interactions) and the per-consult cost of VCNS ($69 versus $122). This allowed us to observe how changes in utilization volume and VCNS consultation costs would impact the total savings from avoided in-person services and the resulting net benefits.

Results
The results from various data sources are combined and organized by the specific VC@YL evaluation objectives, which they inform, including program utilization and community awareness; removing barriers and addressing equity in virtual care access; patron and staff experience; and economic analysis.

Program utilization and community awareness
The number of beneficiaries was the number of individuals interacting with the program staff hired for the project. Five hundred eighteen unique beneficiaries interacted with the program as of January 15th, 2024. A total of 1,073 interactions took place during this period, denoting follow up requirements, digital literacy support and retries if VCNS was fully booked. Cumulatively, 100% (518/518) of the unique individuals who interacted with the project completed their VCNS appointments or were in the process of doing so.

Characteristics of patrons of the VC@YL who responded to the survey are presented in Table 1. There were 290 patron survey responses as of January 15, 2024. Among those, 29 were excluded from the analysis because they were mostly incomplete, leaving 261 respondents for this analysis. Patrons were able to complete the survey each time they used the service but were only asked to complete demographics-related questions

Table 1 Characteristics of patrons who used Virtual Care @ Your Library

	n (%)
How would you rate your overall health?	**n = 261**
Poor	9 (3.4%)
Fair	69 (26.4%)
Good	137 (52.5%)
Very Good	69 (26.4%)
Excellent	9 (3.4%)
How many times have you used this service?	**n = 249**
This was my first time	161 (64.7%)
2-3 times	61 (24.5%)
4-5 times	16 (6.4%)
More than five times	11 (4.4%)
How do you identify?	**n = 175**
Man	71 (40.6%)
Woman	102 (58.3%)
Transgender Woman	1 (0.6%)
Prefer not to answer	1 (0.6%)
Please indicate your age category.	**n = 179**
24 years or younger	4 (2.2%)
25-34 years	5 (2.8%)
35-49 years	12 (6.7%)
50-64 years	43 (24.0%)
65 years or older	115 (64.2%)
Please indicate the highest level of formal education that you have completed.	**n = 179**
Grade school	7 (3.9%)
Some high school	28 (15.6%)
High school	64 (35.8%)
Some university/college/trade/vocational	11 (6.1%)
College/trade/vocational	56 (31.3%)
University – undergraduate degree	9 (5.0%)
University – post-graduate degree	8 (4.5%)
Prefer not to answer	1 (0.6%)

if they indicated it was their first time responding to the survey. Staff completed a total of 26 surveys during the program.

As of January 15, 2024, 518 unique individuals interacted with the VC@YL program, resulting in a total of 1,073 interactions. This indicates that many individuals used the service more than once. Patron survey data supports this, showing that among the 249 respondents who answered the question about frequency of use, 161 (65%) indicated it was their first time using the service, while 88 (35%) were repeat users (Table 1). These repeat users were distributed as follows: 61 used the service 2–3 times, 16 used it 4–5 times, and 11 used it more than five times (Table 1).

The majority of VC@YL patrons were 65 and older (64.2%, 115/179). The proportion of individuals from this age group using VC@YL was much higher than the proportion eligible based on the NFPR, where only 28.7% of the population is 65 and older. More women than men

participated in the program, and over 83.2% (149/179) indicated high school or higher as the highest level of formal education completed.

Many patrons heard about the VC@YL initiative through pharmacy referrals (23.4%, 61/260) and the emails sent by NSH (21.9%, 57/260) (Table 2). Library or staff members (11.1%, 29/260) and "other" sources (21.2%, 55/260) were also common referral sources. Social media was the least cited option, which the program staff believed was due to users' demographics and digital literacy.

Stratification of responses by first time users vs. repeat users (Table 2) revealed that repeat users were more likely than first-time users to have learned about the program through a pharmacy referral (35.6%, 31/87 vs. 18.1%, 29/160), whereas first-time users were more likely to have heard about it via an email from Nova Scotia Health (26.3%, 42/160 vs. 16.1%, 14/87).

Removing barriers and addressing equity in virtual care access

When patrons were asked, "What are your primary reasons for using the library to access services?" The most common reasons for use were, "I need support to navigate access to virtual services" (77.6%, 128/165) and "I have difficulty knowing how to join by computer, phone, or device" (75.4%, 196/260). These results suggest that computer literacy is a primary barrier for patrons accessing virtual care. This is supported by the virtual care program staff's experience, as demonstrated by responses from the staff survey, where 88% of staff selected "Support for users who have difficulty knowing how to join by computer, device, or by phone" as a benefit to the virtual care offering (Table 3).

Repeat users were more likely to report technological barriers, including lack of access to a computer, phone, or device (32.2%, 28/87 vs. 13.8%, 22/160), no access to cellular service or internet (26.4%, 23/87 vs. 9.4%, 15/160), and poor internet connection (12.6%, 11/87 vs. 3.1%, 5/160). Repeat users were also more likely to indicate a need for assistance navigating virtual care services (89.7%, 61/68 vs. 67.9%, 57/84) yet were less likely than first-time users to report difficulty understanding how to join a virtual visit using a computer, phone, or device (67.8%, 59/87 vs. 81.3%,130/160).

Patron and staff experience of Virtual Care @ Your Library
Patrons mostly indicated positive or very positive experiences using virtual technology (Table 2). However, approximately 5% had negative or very negative experiences, suggesting that despite the help from the initiative, some will still struggle with the technology required for virtual care access. Patron experience accessing virtual care services through the program was overwhelmingly

Table 2 Patron awareness of and satisfaction with the Virtual Care @ Your Library program

	All Users	First-time Users	Repeat Users
How would you rate your experience with virtual care technology today?			
	n = 260	*n* = 160	*n* = 87
Very Positive	66.2%	63.1%	73.6%
Positive	22.3	26.9%	16.1%
Neutral	5.4%	4.4%	3.5%
Negative	3.5%	3.8%	3.5%
Very Negative	2.7%	1.9%	3.5%
How would you rate your experience engaging library staff today?			
	n = 162	*n* = 84	*n* = 68
Very Positive	88.9%	82.1%	95.6%
Positive	11.1%	17.9%	4.4%
Neutral	0%	0%	0%
Negative	0%	0%	0%
Very Negative	0%	0%	0%
How would you rate your experience accessing virtual care at the library site?			
	n = 260	*n* = 161	*n* = 87
Very Positive	82.7%	84.5%	83.9%
Positive	15.0%	11.8%	16.1%
Neutral	2.3%	3.7%	0%
Negative	0%	0%	0%
Very Negative	0%	0%	0%
How did you hear about the service?			
	n = 260	*n* = 160	*n* = 87
Email from Nova Scotia Health	21.9%	26.3%	16.1%
Pharmacy Referral	23.5%	18.1%	35.6%
Library staff member	11.2%	11.3%	10.3%
Newspaper or radio	7.3%	7.5%	4.6%
Physician or nurse practitioner	5.0%	6.3%	3.5%
Facebook	2.3%	3.1%	0%
Handout	7.3%	4.4%	11.5%
Other	21.5%	23.1%	18.4%
What are your primary reasons for using the library to access services?			
	n = 260 (*N* = 479[*])	*n* = 160 (*N* = 248[*])	*n* = 87 (*N* = 204[*])
I need support to navigate access to virtual services[**]	77.6%	67.9%	89.7%
I have difficulty knowing how to join by computer, phone, or device	75.4%	81.3%	67.8%
I do not have a computer, phone, or device	20.4%	13.8%	32.2%
I have no access to cellular service or internet	15.8%	9.4%	26.4%
Internet connection is poor	6.9%	3.1%	12.6%
Using the library is more convenient for me than taking my appointment at home	13.5%	8.8%	21.8%
I do not have a private space at home to take my appointment	1.2%	0.6%	2.3%
Other	1.9%	2.5%	1.2%
If you had not used the virtual care services provided, where would you have sought care?			
	n = 256	*n* = 158	*n* = 85
Don't know	32.8%	27.2%	43.5%
Emergency department	31.6%	39.2%	21.2%
Walk-in clinic	19.1%	22.1%	14.1%
Nowhere	11.3%	7.0%	16.5%
Look up symptoms online	1.2%	0.63%	2.4%
Other	3.9%	3.8%	2.4%

[*]indicates a multi-select question where *N* = total number of selections

[**]indicates response option was added part way through data collection so *n* = 165 responses

Table 3 Staff support and perceived benefits of Virtual Care @ Your Library

	n (%)
How much time did you spend helping Patrons (per user)?	**n = 26**
Less than 15 minutes	17 (65.4%)
16-30 minutes	4 (15.4%)
31-60 minutes	4 (15.5%)
More than 60 minutes	1 (3.8%)
How supported, informed, and/or equipped do you feel in your role in this initiative?	**n = 24**
Very Unsupported	0 (0%)
Somewhat Unsupported	0 (0%)
Neutral	1 (4.2%)
Somewhat Supported	3 (12.5%)
Very Supported	20 (83.3%)
From your experience and feedback that you have heard from users, what do you think are the benefits of providing virtual care service offerings at the library site?	**n = 26**
Support for users who have difficulty knowing how to join by computer, device, or by phone	23 (88.5%)
Support for users who do not have access to a device, such as a computer, tablet, or phone	11 (42.3%)
Support for users who do not have access to cellular service, internet, or internet connection is poor)	10 (38.5%)
Private space for users who do not have a private space to take their appointments at home)	1 (3.8%)
Convenience for users who would prefer the library over using virtual care services at home)	0 (0%)
Other	1 (3.8%)
None of these apply	1 (3.8%)
What is the overall rating of your experience being part of the virtual care offerings at the library site?	**n = 25**
Very Poor	0 (0%)
Poor	0 (0%)
Neutral	5 (20.0%)
Positive	6 (24.0%)
Very Positive	14 (56.0%)

positive, with 97.7% indicating a positive or very positive experience and no patrons indicating negative experiences (Table 2). Only small differences existed in patron experience ratings of the program between first time users and repeat users (Table 2).

More than 80% (20/24) of library staff reported feeling very supported in their role in this initiative and that they were informed and equipped to help patrons (Table 3). The majority also indicated that their experience being part of the program was positive (24.0%, 6/25) or very positive (56.0, 14/25%). Most contacts with patrons required less than 15 min of library staff time (Table 3).

Economic analysis results
Project costs
The economic model accounted for one-time and recurring service implementation and maintenance costs. One-time costs included staff training ($4,713), communication and promotional efforts ($3,770), and accessibility upgrades ($5,656) to ensure inclusive service provision (Table 4). The primary ongoing cost was the employment of a library virtual care technician over two years, amounting to $78,922. The total project cost was $93,061 (Table 4).

Cost per visit
The cost per VC@YL visit was $87 across all scenarios. However, the cost per VCNS differed depending on the scenario, with a base cost of $69 in the reference case and Scenario 2, while rising to $122 in Scenario 1 and Scenario 3. The total cost per VC@YL visit was $156 (VCNS + VC@YL) in scenarios where VCNS was priced at $69 and increased to $209 in cases where the VCNS cost was $122. In comparison, the cost per ED visit was set at a fixed value of $341. The net savings per avoided ED visit were $185 in the reference case and Scenario 2 but decreased to $132 in Scenario 1 and Scenario 3 due to the increased VCNS consultation cost. The cost per walk-in clinic visit was $146 across all scenarios. However, since the VCNS consultation cost exceeded this amount in scenarios where it was priced at $122, avoiding a walk-in visit resulted in a net loss rather than a savings. Specifically, the cost saved per avoided walk-in clinic visit was -$10 in the reference case and Scenario 2, but it increased to -$63 in Scenario 1 and Scenario 3 (Table 4).

Avoided visits and associated savings
In the reference case and Scenario 1, 166 ED diversions were recorded, whereas in Scenario 2 and Scenario 3, the increased number of VC@YL interactions led to 343 ED diversions. Similarly, 98 walk-in clinic diversions

Table 4 Economic analysis results

Category	Reference case (*N*= 518)	Scenario 1 (*N*= 518)	Scenario 2 (*N*= 1073)	Scenario 3 (*N*= 1073)
Project costs				
One-time costs				
Staff's training	$4,713	$4,713	$4,713	$4,713
Communication and promotion	$3,770	$3,770	$3,770	$3,770
Accessibility for sites (3 accessible workstations)	$5,656	$5,656	$5,656	$5,656
Ongoing costs				
Library VC technician (Two years)	$78,922	$78,922	$78,922	$78,922
Total project cost	$93,061	$93,061	$93,061	$93,061
Cost per VC@YL visit	$87	$87	$87	$87
Cost per VCNS consult	$69	$122	$69	$122
Total cost per visit (Assuming all visits result in virtual care consult)	$156	$209	$156	$209
Cost per ED visit	$341	$341	$341	$341
Net savings per ED visit avoided	$185	$132	$185	$132
Cost per walk-in clinic visit	$146	$146	$146	$146
Cost saved per walk-in clinic avoided	-$10	-$63	-$10	-$63
Number of ED diversions	166	166	343	343
Number of Walk-in clinic diversions	98	98	204	204
Savings from ED diversions	$30,710	$21,925	$63,614	$45,416
Savings from walk-in diversions	-$1,001	-$6,217	-$2,073	-$12,878
Total savings	$29,710	$15,708	$61,541	$32,538
Savings per person	$57	$30	$57	$30

In the reference case, we assumed that all the 518 unique individuals who used the service. We also assumed that the proportion of that number that resulted in ED visits avoided was 0.32 and assumed 0.19 for the proportion of walk-in-clinics avoided. In Scenario 1, we assumed that the cost of a virtual care consult increased from $69 to $122. In Scenario 2, we used the total number of interactions and assumed Virtual care consult cost is $69. We increased this amount to $122 in Scenario 3

occurred in the reference case and Scenario 1, while 204 were observed in Scenarios 2 and 3 (Table 4).

The cost savings from these diversions varied based on the scenario. In the reference case, ED diversions resulted in cost savings of $30,710, whereas Scenario 1, which incorporated higher VCNS consultation costs, yielded a lower ED savings total of $21,925. In Scenario 2, the increased utilization led to $63,614 in ED savings, but in Scenario 3, where VCNS consultation costs were higher, ED savings dropped to $32,538. The savings from avoided walk-in visits were negative in all cases due to the cost structure of VCNS (Table 4).

Total cost savings and per-person cost benefits
The reference case yielded an overall savings of $29,710, which decreased to $15,708 in Scenario 1 due to the increased cost per VCNS consultation. Scenario 2 demonstrated the highest monetary benefit, with total savings of $61,541, reflecting the positive effect of increased utilization when VCNS consultation costs remained at $69. However, when the consultation cost was raised to $122 in Scenario 3, total savings decreased to $32,538. From a per-person perspective, the monetary benefit was calculated by distributing the total savings across the respective population sizes. The reference case and Scenario 2,

both of which assumed a VCNS consultation cost of $69, resulted in savings of $57 per person. In contrast, Scenario 1 and Scenario 3, which adopted the higher consultation cost of $122, reduced per-person savings to $30.

The results are indicative that increasing VCNS consultation costs significantly reduces net savings in absolute terms and per person. Conversely, increasing VC@YL utilization substantially improves cost-effectiveness, particularly when consultation costs remain at the lower threshold of $69.

Discussion
Virtual care services require a high level of digital literacy, which is a known barrier to accessing virtual care for certain demographic and socioeconomic groups, particularly older adults [6]. Other barriers include broadband availability, the necessary up-to-date technology and devices, and the person having a safe space to attend the appointment. The VC@YL initiative was a multi-institutional collaboration bringing together public libraries, government entities, and a health foundation to facilitate access to virtual care services through a community-based setting. The program aimed to address barriers to accessing virtual care services by providing a physical

space for users with the necessary technologies and a technician to assist patrons with any difficulties.

The initiative created a new access point for healthcare in the community, with almost 1,100 interactions utilizing the service in some capacity during the evaluation period. It provided a service that enabled people to access virtual primary care services that otherwise would not have been available due to access barriers. Most beneficiaries were older adults, and a majority indicated they chose to use the service due to difficulty knowing how to use the technology associated with virtual care and accessing virtual care services. Most patrons had a positive experience using the service, and library staff indicated they felt supported and that it was not a significant burden.

The observed differences between first-time and repeat users suggest that ongoing reliance on the service is closely linked to persistent technological barriers. Repeat users were more likely to report lacking access to a device or reliable internet, which likely necessitated continued use of the program as their only means of connecting to virtual care. In contrast, first-time users more frequently cited difficulties in knowing how to join a virtual visit, a barrier that could be resolved after initial guidance, reducing the need for repeat visits. The greater proportion of repeat users seeking assistance navigating virtual care pathways further reinforces this idea, suggesting that they faced more complex or persistent challenges beyond a one-time learning curve. Differences in referral sources also suggest that first-time users may have been more likely to engage with the program through direct health system outreach, (i.e., emails form Nova Scotia Health), which would have been a convenient and accessible way to learn about the service for those with digital access. In contrast, repeat users, particularly those with technological barriers, may have been more reliant on community-based referrals, such as pharmacies, which provided an alternative means of awareness for individuals with limited internet access. This highlights the importance of employing multiple outreach strategies, ensuring that individuals with limited digital access are reached through alternative, community-driven channels.

This cost-benefit analysis demonstrates that the VC@YL initiative can reduce healthcare costs. The results indicate that ED visit diversions contribute significantly to cost savings, with each avoided ED visit saving an estimated $185 in scenarios where VCNS costs remain at $69 per consult and $132 when VCNS costs increase to $122 per consult. Conversely, walk-in clinic diversions do not generate cost savings, as the cost of accessing virtual care in this context, comprised of both the VC@YL and VCNS, often exceeds the cost of an in-person clinic visit.

The analysis demonstrates that higher VC@YL utilization improves cost sustainability. In Scenario 2, where

total VC@YL interactions increased to 1,073 while maintaining a lower VCNS consultation cost ($69 per consult), total savings nearly doubled compared to the reference case. However, Scenario 3, which assumed both increased utilization and higher consultation costs ($122 per VCNS consult), resulted in lower overall savings.

A critical aspect that extends beyond monetary considerations is the public health and equity impact of VC@YL. VC@YL expands access for individuals who might otherwise forgo care due to digital literacy challenges, lack of internet access, or privacy concerns. While these benefits are not captured in direct cost savings, they represent a significant value-add in enhancing healthcare accessibility and potentially improving long-term health outcomes for underserved populations.

During the steering committee meetings, several implementation challenges and enablers identified by the technician were noted. The range in digital literacy abilities of patrons was very large, with some patrons able to navigate the virtual care program after a single interaction with the program staff, and others needing ongoing support. The high number of repeat users we observed through the survey supports this and suggests that the services should be maintained continuously. Some unforeseen challenges were encountered during the project, including patrons who requested program staff stay in the room with them for their medical appointments and patrons arriving at the library with more serious conditions that required emergency care. Creating clear protocols at the program's initiation to guide staff in these situations would be beneficial. An important aspect identified for the initiative's success at the outset was providing a private room for patrons to conduct medical appointments. However, the program staff reported that most patrons primarily needed assistance with platform navigation and account setup. This aligns with the patron survey, where the majority indicated they needed technical assistance. Subsequently, patrons preferred to have consultations from the convenience of their homes. This suggests that other settings can still benefit from implementing a virtual care assistance program, even without dedicated appointment spaces.

Conclusions
Libraries and other community centers have been identified in the literature as settings that are well-positioned to facilitate access to virtual care services. This pilot demonstrated this notion and helped expand community access to new and existing primary care pathways in Nova Scotia, including VCNS. While this project mainly supported the VCNS platform, other opportunities exist for libraries to grow linkages and support other healthcare programs, including some virtual care and digital platforms used in acute care, EDs, ambulatory care, mental health, home

health monitoring, digital front doors (patient portals) and chronic disease prevention, especially in the area of group patient education sessions. The findings from this study will inform planning for equitable access to virtual and digital health initiatives. As of the time of writing this manuscript, no expansion plans were in place.

Limitations

This pilot project consisted of three rural libraries in Nova Scotia, potentially limiting the generalizability of the results. Most of the data was collected through voluntary patron surveys, and we had a response rate of approximately 50%. This makes the results susceptible to selection biases, as there are likely key differences between all users and those who responded to the survey. Survey distribution was improved through adding a printed copy of the survey, which provided access for respondents unable to use the internet. We are unable to characterize who remains unserved or underserved by this project. We also do not have a defined control group.

A limitation of this study is the variability in response rates across survey questions, influenced by the design decision to allow participants to skip repetitive questions in subsequent surveys. Patrons were only asked to complete demographics-related questions if they indicated it was their first time responding to the survey. While this approach was intended to minimize respondent burden, it resulted in differing denominators for specific survey items, potentially affecting the interpretation and generalizability of the findings. Differences in the subsets of respondents answering each question could introduce bias, particularly if certain demographics or participant characteristics are systematically underrepresented in specific responses. These variations may limit the ability to draw consistent conclusions or make direct comparisons across survey items.

Another limitation of this study is the lack of analysis regarding the differences in demographics and engagement patterns between patrons who utilized VCNS services at the library versus those who accessed the service from home. This data could provide valuable insights into the factors influencing access and utilization across different environments. The absence of such an analysis limits our ability to fully understand the contextual differences in service usage.

The cost-benefit analysis has several limitations that should be considered when interpreting the results. The analysis relied on stated preference data, as the proportions of ED and walk-in clinic visits avoided were derived from responses to survey questions rather than revealed preference data based on observed behaviours. While these stated preferences provide a foundation for the evaluation, they may not fully capture the real-world complexity of healthcare utilization. The analysis

assumed fixed ED visit and walk-in clinic costs, but these can vary depending on hospital location, patient acuity, and system-wide cost fluctuations. Furthermore, the assumption that avoiding an ED visit directly results in cost savings may be overly simplistic, as many ED costs are fixed rather than variable. A marginal cost approach, which considers how reductions in patient volumes impact hospital costs, would provide a more precise estimate of cost impact.

Also, the analysis did not account for downstream costs or savings resulting from changes in patient health outcomes due to VC@YL use. Earlier access to care through VC@YL could potentially reduce long-term healthcare costs by preventing complications or hospitalizations. Conversely, there may be downstream costs related to follow-up care initiated by VC@YL consults. Excluding these downstream impacts limits the ability to fully capture the program's economic implications over time.

A further limitation of this study is the lack of age-specific cost data, particularly given that 64.2% of patrons were over 65 years old. While the high proportion of older adults using the service highlights its relevance for this demographic, we did not have access to individual-level cost data to assess the economic impact by age group. Instead, the analysis focused on the overall cost per consult and cost savings per consult. This approach was necessitated by the absence of disaggregated data for specific age groups. Future analyses would benefit from incorporating age-specific costs to better reflect the economic implications for different age groups.

Despite these limitations, the findings offer valuable insights into the cost-effectiveness of VC@YL as a complement to traditional healthcare services and highlight the potential for monetary and operational benefits under various utilization scenarios. The quantification of ED cost savings strengthens the case for investing in virtual triage and digital health solutions to optimize emergency department utilization.

Abbreviations

NSH	Nova Scotia Health
VCNS	Virtual Care Nova Scotia
NFPR	Need a Family Practice Registry
VC@YL	Virtual Care @ Your Library
PARL	Pictou Antigonish Regional Libraries
NSH IM/IT	Information Management/Information Technology
StaRI	Standards for Reporting Implementation Studies
RE-AIM	Reach, Effectiveness, Adoption, Implementation, and Maintenance
ED	Emergency Department
REDCap	Research Electronic Data Capture
CBA	Cost-Benefit Analysis
ROI	Return on Investment
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
PSA	Probabilistic Sensitivity Analysis

Supplementary Information

> Supplementary Material 1. Roles and responsibilities of technicians in supporting the Virtual Care @ Your Library program.
>
> Supplementary Material 2. Training components for library technicians and staff in support of virtual care services.
>
> Supplementary Material 3. Patron Survey (English Language).
>
> Supplementary Material 4. Staff Survey (English Language).
>
> Supplementary Material 5. Model inputs for Economic Analysis.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and was approved by the Nova Scotia Health Research Ethics Board (REB File #: 1027001). Participation was entirely voluntary, and informed consent was implied by participants choosing to complete and submit the anonymous survey. This consent procedure was approved by the Ethics Board and is in accordance with the Canadian Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2), which permits implied consent for minimal-risk research involving anonymous questionnaires. All responses were kept confidential, and data were anonymized to protect participants' privacy.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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