CHILD AND ADOLESCENT VIRTUAL MENTAL HEALTH CARE AND DURATION OF TREATMENT: A RETROSPECTIVE COHORT STUDY

by

Allyson Cruickshank

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ABSTRACT

The public health restrictions resulting from the COVID-19 pandemic required significant changes to the delivery of outpatient child and adolescent mental health services, from primarily in-person to primarily virtual care. The rapid shift to virtual care did not permit time for planning or evaluating its implementation. While necessary to maintain access to services, there were questions regarding its impact on services, including the duration of treatment episodes.

We aimed to 1) describe episodes of care by treatment modality among children and youth receiving outpatient IWK Mental Health and Addictions (MHA) services between June 30, 2018, and November 2, 2023; 2) determine whether client characteristics influence observed associations between treatment modality and episodes of care for fiscal years 2019 to 2022; and, 3) determine whether system factors further contribute to observed associations between treatment modality and episodes of care for fiscal years 2019 to 2022.

We created episodes of care using the definition 'periods of service use with fewer than 90 days between care contacts. Episode duration was captured both in terms of the numbers of visits and days, and normalized as a ratio of days to visits within an episode of care to allow their comparison and assess any influence of intersession wait times. We described periods of service use for in-person, virtual, and hybrid care. To analyze the association between treatment modality and duration and adjust for client and system characteristics, we used a multilevel mixed-effects negative binomial model (visits), a time-to-event analysis (days), and a zero-inflated negative binomial model (ratio of days to visits).

We found that virtual episodes of care were associated with more visits (IRR = 1.43; CI: 1.28, 1.60; $p<0.01$) and took longer to complete in days (HR: 0.64; CI: 0.54, 0.76; $p<0.01$) compared to in-person episodes of care between April 1, 2020, and March 31, 2021. However, between April 1, 2022, and March 31, 2023, virtual episodes of care were associated with fewer visits (IRR = 0.87; CI: 0.81, 0.95; $p<0.01$) and concluded sooner in days (HR: 1.10; CI: 0.97, 1.25; $p>0.05$) compared to in-person episodes of care. These patterns were consistent after adjusting for client and system factors. Additionally, we found that there was no significant difference in the ratio of days to visits between the virtual and in-person treatment modalities (IRR=1.01; CI: 0.98, 1.04; $p>0.05$), indicating no effect of intersession wait times on differences in treatment length by modality.

Our findings may reflect increasing confidence or comfort with using virtual care for child and adolescent mental health care, or client and system characteristics not captured in administrative data. With increasing choice in modality post public health restrictions, understanding differences in treatment trajectories, including duration and outcomes, will be important for supporting clinical and system decision-making.

LIST OF ABBREVIATIONS USED

ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
CAPA	Choice and Partnership Approach
CIHI	Canadian Institute of Health Information
CBT	Cognitive Behavioural Therapy
CI	Confidence Interval
CMHA	Community Mental Health & Addictions
HR	Hazard Ratio
IQR	Inter-Quartile Range
IRR	Incidence Rate Ratio
IWK	Izaak Walton Killam
MDN	Median
MHA	Mental Health & Addictions
OCD	Obsessive Compulsive Disorder
SMH	School Mental Health
TH	Telehealth

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CHAPTER 1: INTRODUCTION

The COVID-19 pandemic has had a significant impact on the mental health and well-being of many individuals, with young people bearing a disproportionate weight of this impact (1). With disruptions to daily routines, social isolation, and increased stress and anxiety, many children and adolescents have experienced new or intensified mental health challenges (2). The need to address youth mental health concerns became amplified during the pandemic, with calls for supports and resources to help young people navigate these unprecedented times.

The public health restrictions related to the COVID-19 pandemic requiring physical distancing created the need for mental health service delivery to rapidly shift from primarily in-person to primarily virtual to ensure continued access to services. This rapid shift left little time to plan implementation or examine the effectiveness of the wide-scale adoption of virtual mental health care prior to implementation (3). Despite some evidence regarding its effectiveness and acceptability to clients prior to the COVID-19 pandemic, many clinicians had been reluctant to adopt virtual care as they believed it impedes their ability to build rapport with clients and detect non-verbal cues, which could be detrimental to providing effective care (4,5).

However, access to mental health services for children and adolescents has been a growing challenge for several years (6). Virtual care may play an essential role in a hybrid model of care moving forward and may offer several benefits, including more equitable access to mental health services, as virtual care allows an individual to access mental health services from their home or school and reduces the expenses of attending an appointment, such as transportation and missing work (4,7). Additionally, virtual mental health care may offer privacy to those concerned about the stigma associated with entering a mental health clinic, provided the individual has a private space for the virtual appointment. However, there needs to be consideration of the balance between access and convenience with treatment needs and therapeutic considerations, such as the potentially therapeutic benefit of leaving one's home to attend an in-person appointment, as well as

the belief that some clinicians may hold that virtual care is not as effective as in-person care and requires more sessions to achieve similar treatment goals. Virtual care also presents limitations for some, as the technical requirements of virtual care, e.g., access to reliable internet and devices, can create barriers (7). Additionally, there are concerns related to privacy and security, particularly for youth who do not have access to safe or private spaces (4).

To support informed decisions regarding the provision of options for treatment modality, it is crucial to understand the effectiveness and patterns of service utilization of virtual care and determine if this treatment modality is a viable option for youth requiring mental health and addictions interventions. Studies to address the question of the effectiveness of virtual mental health care relative to in-person care are under way (8–10). However, even if modalities are found to be equally effective, or important for ensuring access to services for some, it is important to understand whether the duration of treatment varies by the modality of care. Examining the patterns of service use for both treatment modalities (in-person vs. virtual care), in terms of the duration of treatment (i.e., length of episodes of care in days and visits) can aid in the comprehension of potential differences in service use patterns and inform both clinical shared decision-making regarding modality of treatment and responsive service planning.

This thesis aimed to improve our understanding of how treatment modality may be associated with treatment duration. We utilized administrative data from the Community Mental Health & Addictions (CMHA) services at IWK Health, a children's hospital in Halifax, Nova Scotia, to construct episodes of care as a means to measure treatment duration and to study patterns of care by treatment modality. The objectives of this study were to 1) describe episodes of care by treatment modality among children and youth receiving outpatient IWK MHA services between June 30, 2018, and November 2, 2023; 2) determine whether client characteristics influence observed associations between treatment modality and episodes of care for fiscal years 2019 to 2022; and, 3) determine whether system factors further contribute to observed associations between treatment modality and episodes of care for fiscal years 2019 to 2022.

To meet these objectives, we conducted a retrospective cohort study of episodes of care among children and youth attending IWK CMHA (ambulatory) services between June 30, 2018, and November 2, 2023. We created episodes of care using the definition 'periods of service use with fewer than 90 days between care contacts' using routinely collected health administrative data from CMHA services at IWK Health.

This study may serve as a resource for decision-making at both the program and clinical levels. At the program level, decisions include the possibility of implementing a hybrid model of care, offering clients the informed choice between in-person or virtual care. Such decisions necessitate careful consideration of the lengths of episodes of care for adequate staffing and effective utilization of resources while also factoring in whether a hybrid model supports greater accessibility to mental health services. Clinical decisions between clinicians, clients, and caregivers requires consideration of potential trade-offs between access to care, engagement with services, and clinical needs. The findings of this study also demonstrate a means of operationalising a definition of episodes of care and contribute to the health services literature in support of the transformation of child and adolescent mental health services.

CHAPTER 2: LITERATURE REVIEW AND RATIONALE

2.1 CHILD & ADOLESCENT MENTAL HEALTH

Mental health refers to the mental wellbeing of an individual. Good mental health can be defined as the ability to cope with the normal stresses of life, be a productive member of one's community, and realize one's potential (11). Mental health is not merely the absence of disease but a complex continuum of wellbeing. Each person experiences varying degrees of distress and capability to cope with distress and can be affected by individual, social, and structural determinants (11).

Mental illness represents a significant disturbance in the mental state. Mental illness can be a specific, diagnosable mental health condition characterized by altered thinking, mood, or behaviour, or a combination of these. Mental illnesses also impact functioning and are associated with significant distress (12). The development of a mental illness is complex, and can be affected by genetics, and biological, personality, and environmental factors (12).

Child and adolescent mental health needs and timely access to appropriate services are significant concerns in Canada; approximately one in five children and adolescents have a mental health need that causes significant impact in their day to day lives (13). Most mental disorders emerge during adolescence and early adulthood, with approximately 50% emerging by age 14 and 75% emerging by age 24 (14). The period of adolescence is typically marked by substantial personal development and various academic, social, and personal stressors (15). Thus, experiencing a mental disorder during this period can result in significant difficulties, such as poor social functioning, lower levels of education, reduced vocational attainment, and financial insecurity (16).

2.2 IMPACT OF COVID-19 ON YOUTH MENTAL HEALTH

The COVID-19 pandemic had a significant impact on the mental health of Canadians, causing an increase in the prevalence of depression, anxiety, risk of suicide, insomnia, and post-traumatic stress symptoms (1). However, the effect of the pandemic on mental

health was not equally shared among the population, as certain groups were more vulnerable to the detrimental effects, including older adults, institutionalized individuals, unemployed individuals, and children and adolescents (1). Children and adolescents experienced school closures, resulting in the need to adapt to virtual learning, social isolation from peers, emotional stress, greater exposure to familial conflict, and increased time spent using the Internet and social media, which may worsen mental health (17). Furthermore, the closure of schools, and disruptions to their daily routines and social interactions can negatively impact their sense of structure and predictability and put them at risk of feelings of loneliness and potential deterioration of their mental health (17–20). Additionally, internal factors, such as increases in emotional reactivity and interpersonal stress and lowered emotional regulation that occurs during adolescence, coupled with external factors due to the pandemic, may have resulted in children and adolescents being at an increased risk of experiencing deterioration in mental health (21,22).

Meta-analyses have shown that, globally, the pandemic led to a high prevalence of mental health symptoms, particularly anxiety and depression, in children and adolescents (23–26). While expression of distress would be a normal, expected reaction to a global emergency, some children and adolescents experienced mental health concerns requiring treatment.

In a large cross-sectional study of the impact of COVID-19 emergency measures on child and adolescent mental health among Canadian children, many participants reported a deterioration in their mental health, especially in depression, irritability, attention, and hyperactivity, particularly among those with no known pre-COVID mental health diagnoses and those with pre-existing autism spectrum disorders (ASD) diagnoses (17). However, it was also reported that for other children, pre-existing psychiatric and neurodevelopmental diagnoses were also associated with improvements in anxiety, depression, and irritability. This highlights the variations in child and adolescent experiences during the pandemic. Some children may have benefitted from the COVID-19 pandemic and the public health restrictions. For example, school closures may have provided protection from school-related worries or pressures (20). Additionally, children

may have received more attention or support from family members due to more time spent together (20). Moreover, many children with a pre-existing diagnosis, such as social anxiety or a learning disorder, may have seen a decrease in symptoms of anxiety or irritability due to the restrictions that have provided relief from sources of anxiety and stress (17).

In terms of health service use for mental health concerns, using data from the Canadian Institute of Health Information (CIHI) reporting mental health related hospitalizations for children and adolescents across Canada, it was found that the proportion of mental health related hospitalizations increased from 21% of all hospitalizations in 2019 to 23% in 2020 (27). Also, the proportion of mental health related visits to emergency departments, a common site for crisis mental health evaluations for children and adolescents, increased between 2019 and 2020 (27). Additionally, in 2020, Kids Help Phone reported twice as many interactions compared to 2019 (27). The increase in the proportion of emergency department visits, in addition to the increased Kids Help Phone interactions, may reflect the increased distress experienced among children and adolescents during the pandemic (25). Moreover, the increases in the proportion of mental health-related emergency room visits may relate to the difficulty in accessing community mental health services (25).

2.3 CHILD AND ADOLESCENT MENTAL HEALTH CARE

2.3.1 CHOICE AND PARTNERSHIP APPROACH

The Choice and Partnership Approach (CAPA) is a clinical system created to provide accessible mental health services centered around the child and their caregiver, ensuring the child's and caregiver's needs are appropriately matched to the service (28–30). The CAPA model integrates ongoing quality improvement methods, using data to inform decision-making to ensure services are responsive to clients' needs (29). IWK Health implemented CAPA in 2012 to meet growing wait times and to provide client- and family-centred care, providing various treatment options to meet the needs of clients and their families (31).

Treatment typically begins with a Choice appointment, the first clinical contact, followed by Partnership appointments. The aim of the Choice appointment is for the client and the clinician to discuss the mental health concern, discuss the services and interventions available, and decide together on the next steps (32). For those progressing to treatment, the Choice appointment is followed by Core or Specific Partnership appointments, where the intervention decided upon and begun at Choice continues to help the clients meet their goals. Core Partnership represents the majority of clinical work, with particular assessments, therapies, or clinical skills added in Specific Partnership works as needed (33). Throughout the Partnership appointments, assessment and reformulation continue throughout to ensure clients' needs are being met (34). For some clients, their mental health needs may be better met outside the service or at another time, thus, on average, approximately 30% of clients exit outpatient mental health clinics following a Choice appointment (35).

2.3.2 NEEDS-BASED PLANNING

Planning adequate and appropriate mental health supports and services to support early intervention and optimal outcomes requires the accurate identification of mental health needs. However, there are challenges and gaps in information regarding the measurement of child and adolescent mental health disorders. There is a lack of consensus regarding how to measure and quantify mental disorders at the population level, resulting in a lack of robust evidence surrounding the number of children and youth in Canada with mental disorders (36). This has been a particular challenge following the onset of the pandemic, during which measures of distress, which can be addressed with supports or other lower intensity interventions, are conflated with mental health concerns requiring formal treatment. Additionally, we lack a centralized way to track mental health service use, particularly for ambulatory care and for services offered privately. Furthermore, there is a gap in information regarding the reach of mental health services, which includes information regarding the alignment of the need for mental health services and the receipt of these services (36).

To enhance the provision of timely and appropriate mental health services for children and youth, effective planning is needed for health services to be adaptable and responsive

to changing needs and emerging opportunities. This includes considering potential shifts in needs and the utilization of services, such as virtual care. Needs-based planning involves a comprehensive assessment of the needs of a population and the coordination of resources to support these needs appropriately. A needs-based approach requires three specific areas of information: the population's needs and disease prevalence, the expected and observed levels of service use, and the effectiveness of services. (37). This allows researchers and policymakers to understand the complexity of the needs of a population and to design equitable, effective services to meet these needs. In contrast, utilization-based planning accounts for utilization trends, observing service use, only considering the proportion of the population that accesses care, which does not capture the entire burden of the disease and the needs associated with said disease, or the population needing but not seeking or accessing care (37).

2.4 VIRTUAL CARE

2.4.1 IMPLEMENTATION

The public health restrictions related to the COVID-19 pandemic created the need for mental health service delivery to rapidly shift from primarily in-person to primarily virtual to ensure continued access to services (41,42). Individuals receiving ongoing mental health services had to shift to a new way to access care. The rapid shift in service modality allowed for little opportunity for planning and assessment of the effectiveness of virtual service delivery (3). However, this created an opportunity to study the benefits and limitations of virtual mental health care services.

2.4.2 BENEFITS

The virtual delivery of mental health services offers many benefits. Virtual mental health care can relieve many logistical barriers clients and their families may face when accessing in-person mental health services, such as increasing the accessibility and affordability of mental health services by overcoming transportation problems and geographical distance (43). Many clients and their families appreciate the convenience of virtual care, as it reduces travel time and expenditures, missed work, and childcare responsibilities (7,41,44,45). From clinicians' perspectives, it affords the opportunity to

view the client and their behaviours in their home setting (46,47). Another benefit of virtual care for some is privacy. Accessing mental health services online, rather than attending an in-person appointment, may offer privacy to those concerned about the stigma surrounding seeking mental health care (42,44). Furthermore, virtual care can improve help seeking among those with great difficulty leaving their home environment (10). Virtual care can help to mitigate barriers preventing individuals from accessing mental health care and thus reach people who may have never come in for treatment had virtual care not been an option (7,41,48).

2.4.3 LIMITATIONS

Virtual care also presents some limitations or challenges. Technology, or rather the lack of access to technology and technical difficulties, creates barriers to quality virtual mental health care. Lack of access to a reliable internet connection or to technological devices can exacerbate inequities in access to mental health treatment (49,50). Poor internet connections can affect the video quality, impacting the interactions between the client and clinician and the care being delivered (42,46). Disruptions in virtual care can be particularly distressing to individuals, especially when discussing sensitive topics (49).

There are also concerns surrounding privacy and confidentiality for some when using virtual care. Having the mental health care session in the home creates opportunities for others to hear the discussion, which threatens confidentiality and may also reduce the client's willingness to engage in the session (42,46,49,51).

Having the session in the home comes with distractions, such as electronic devices or other family members, which can impede the quality of the mental health care delivered (45,46). Clinicians have voiced concerns regarding virtual care and the difficulties surrounding maintaining the child's attention and engagement throughout the virtual session, particularly among young children and those with attention difficulties (41,42,47).

Clinicians have also reported that virtual care impacts the ability to detect non-verbal cues. Often, the camera does not show the child's posture and body language, making it difficult to detect small cues and behaviours, which is key to successful sessions (41,46,49).

2.4.4 CLINICIAN PERSPECTIVE

Multiple studies have examined clinicians' opinions surrounding virtual mental health care for children and youth. In a study by Jesser et al. (52), which included 161 psychotherapists practicing in Austria, it was determined that the majority of clinicians felt willing to use virtual care, provided it would ensure the child felt more comfortable using this modality. However, most still view virtual care as the backup option when providing in-person care is not possible. Multiple studies found that clinicians agreed on the usefulness of virtual care as it reduces logistical barriers for children and their families (41,45,47). Nevertheless, many clinicians found engaging the child through virtual care methods, developing rapport, and providing effective support challenging (41,47). They found it challenging to detect non-verbal communication, which can affect the therapeutic relationship, leading to the perspective that there is a reduced quality of care (47,52).

2.4.5 CHILDREN'S PERSPECTIVE

A limited number of studies feature children's and youth's perspectives of virtual mental health care. Mekori-Domanchevsky et al. (53) surveyed 44 adolescents living in Israel who were currently receiving mental health services. The study aimed to understand the experience of adolescents with the transition to online mental health services. Many adolescents reported they were satisfied with the care received through online methods. However, a key disadvantage that was reported is the difficulty in building a therapeutic connection (53).

Ramzan et al. (51) aimed to understand the experiences of adolescents using dialectical behaviour therapy via teletherapy. This study included 13 adolescents in the United Kingdom currently enrolled in a dialectical behaviour therapy program. The themes that

emerged from this study included loss of connection with the therapist, limited privacy during sessions, and convenience and accessibility.

A recent study conducted by Danseco et al. (42) in Ontario, Canada, focused on investigating the experiences of agency leaders, service providers, and clients in planning, implementing, and accessing virtual care for child and youth mental health services. The study found that young people were generally open to virtual care and found it easy to use and effective. They also appreciated the flexibility it provided and intended to continue using it. However, some challenges were identified, including technical issues, internet connectivity, and privacy concerns. Despite these challenges, the study concluded that virtual care is an important alternative for accessing care, even for those who prefer in-person care (42).

2.4.6 APPROPRIATE CLIENT POPULATION

Virtual mental health care may not be appropriate for all clients. Virtual care may be better suited for older children, those with good access to technology, those with transport difficulties, and those already engaged in services and have a stable presentation (47,54). Virtual care may not be the most appropriate choice for younger children, those with attention difficulties, those with unstable diagnoses who are considered to be high-risk, and those newly entering services (7,42,46,47). Moreover, children with a physical disability, such as deafness or blindness, may have difficulties participating in virtual care (46). Also, language barriers may be more challenging to address with virtual care due to difficulties incorporating interpreters into the virtual care modality (7,49).

2.4.7 EFFECTIVENESS

Some clinicians have expressed concerns about the effectiveness of virtual care compared to in-person care. Few studies have researched the effectiveness of virtual care compared to in-person care, featuring comparable services to those offered in CMHA, with synchronous, clinician-led virtual care and have shown promising results. However, these studies have limitations, such as small sample sizes and a lack of control groups.

A study conducted by Porter et al. (9) in the United Kingdom explored the effectiveness and acceptability of cognitive behavioural therapy (CBT) delivered through virtual methods. This study included 989 children and youth who received at least one online CBT session. The study concluded that online CBT is an effective treatment for reducing symptoms, as 31–38% of children and youth had a reliable reduction in reported symptoms of anxiety and depression (9). This study provides an understanding of how virtual care may be useful in providing adequate care; however, this study lacks a comparative group; therefore, it cannot be conclusively determined if the reduction in symptoms can be attributed to the treatment provided (9).

Similarly, a study conducted by Uysal et al. (55), which examined the effects of online CBT-based anxiety and depression management psychoeducation among 32 children youth ages 14 to 20, found that these programs delivered via Zoom resulted in statistically significant decreases in levels of anxiety and depression. This study suggests that online CBT may be a viable option for those unable to access in-person services. However, the limitations of this particular study include a small sample size, lack of a control group, and a high level of attrition (59% dropout rate) - thus, the study is unable to conclusively attribute the decreases in levels of anxiety and depression solely to the online CBT programs.

In a study conducted by Hollmann et al. (10) that included 60 children and adolescents with a diagnosis of obsessive compulsive disorder (OCD), it was found that therapist-delivered CBT via videoconference significantly reduced OCD symptoms. This study randomly assigned participants to a treatment or waiting list group. Those in the treatment group received 14 sessions of internet-based CBT over 16 weeks, and participants in the waiting list group began treatment after a waiting period. According to the Children's Yale-Brown Obsessive-Compulsive Scale, OCD symptoms significantly decreased in the treatment group compared to the waiting list group. Those in the waiting list group also demonstrated reduced symptoms after receiving treatment.

2.4.8 IMPACT ON TREATMENT DURATION

To our knowledge, there have not been any studies examining the effect of treatment modality on treatment duration. However, there have been speculations regarding how virtual care may impact treatment duration. Adam et al. (43) proposed that virtual care, particularly CBT for OCD symptoms, may reduce treatment duration in days. It was thought that because virtual care reduces the need to attend in-person appointments, treatment can be intensified, meaning more sessions can be provided in less time, thus reducing treatment duration in days. However, simply having online treatment, particularly regularly scheduled treatment sessions through a virtual medium, would not necessarily result in a shorter treatment duration.

Previously collected administrative data from the IWK MHA Program demonstrated an increase in the average number of visits per client per year during the pandemic, which aligns with the perception that many clinicians hold that virtual care is not as effective as in-person care and requires more sessions to achieve similar treatment goals (50). However, this average does not distinguish between types of episodes of care. For example, it may reflect fewer but longer episodes per individual or higher numbers of shorter interactions with the service. Further, it is unknown whether this can be attributed to virtual care (or lack of experience with virtual care), differences in treatment needs or acuity of presentation during the pandemic, or differences in system factors such as wait times for treatment and intersession wait times contributing to stalled progress therapeutically (56).

2.5 EPISODES OF CARE

Childhood mental health concerns are often ongoing or recurring, and the need for mental health services fluctuates over time; thus, the use of mental health services by children and youth occurs in episodes (57,58). Measures of episodes of care are useful for differentiating between patterns of service use, providing insight regarding the frequency of visits, treatment length, and discontinuation rate (59). Although episodes of care are unable to provide information regarding the quality or appropriateness of care on their own, they provide valuable information regarding expected treatment trajectories (59).

An episode of care is defined as a period of service use associated with a presenting concern, during a distinct, clinically meaningful period of need. The definition of an episode of care should capture meaningful clusters of care contacts, beginning when a client presents to a service with a mental health concern and ending when the mental health care is considered completed, either through meeting of agreed upon goals or through loss to follow up (57).

Episodes of care have previously been used in the literature to use administrative data to answer questions relevant to mental health care and service delivery. Saloner et al. (59), used episodes of care to quantify problems with continuity and better understand the adequacy of mental health care for children. They defined an episode of care as periods of service use with no more than 12 weeks without contact. Rossi et al. (60), Cook et al.(61), and Tansella et al.(62) also defined episodes of care as mental health use with no more than 90 days between visits when researching mental health service use.

Additionally, Edbrooke-Childs et al. (63), used episodes of care to identify predictors of service use from child and adolescent mental health services. They defined an episode of care as periods of service use consisting of at least two care contacts and less than 180 days between care contacts. Sarmiento & Reid (58) employed episodes of care to examine rates and predictors of re-accessing community mental health services for children and adolescents. They defined episodes of care as a minimum of three visits, with less than 180 days without visits.

There is no single operational definition of an episode of care to be used when analyzing administrative data. Reid et al. (57) analyzed administrative data from three childhood mental health agencies in Canada over seven years, comparing various operational definitions of episodes of care. They recommended that an episode of care be defined as a minimum of three visits with no more than 180 days between contact when conducting analyses of childhood mental health administrative data. However, we do need to consider the service being studied and its policies, procedures, treatment model, and service use patterns. It can be challenging to establish boundaries for episodes of care,

especially for individuals with intermittent service use patterns; however, in this study, a new episode was defined as treatment initiated after greater than 90 days without a care contact. This is based on the IWK policy to consider contacts after a 90-day period to be new episodes and require a Choice appointment for the joint formulation of problems to be addressed and treatment decisions (including no treatment). While the new episode of care may continue with care as provided for a previously diagnosed mental health concern, the individual may have a new specific need at that point in time, which is assessed at the onset of the new episode (59).

2.6 CLIENT AND SYSTEM CHARACTERISTICS

Understanding the factors influencing treatment duration is crucial for accurate service planning, resource allocation, and describing expected treatment trajectories. While the impact of treatment modality on treatment duration is our primary interest, it is essential to acknowledge the potential influence of other variables that may affect the relationship between treatment modality and treatment duration.

Although multiple clinical and system factors could influence this relationship, we have focused on those currently available within the dataset and clinically relevant, including demographic variables such as age and sex, as well as clinical indicators such as presenting concern and acuity at presentation. Additionally, system factors such as urgent and non-urgent streams, Core and Specific Partnership visits, the specific clinic where treatment took place, and the time period may also play a role in influencing treatment timelines.

Although there is limited literature directly addressing how these variables influence the choice of treatment modality or treatment duration, it is recognized that these factors could influence the child's mental health, symptom severity, and the type of treatment received (4,64). For instance, age and sex may impact symptom presentation and help-seeking behaviors (64,65). Presenting concern and acuity could influence clinicians' decisions regarding the appropriate treatment modality and trajectories (4,66). Moreover, variations in clinic practices, urgent and non-urgent streams, Core and Specific

Partnership visits, and time periods following the onset of the pandemic may affect the availability and delivery of different treatment modalities.

2.7 SUMMARY OF THE CURRENT GAPS

The literature review in this chapter highlights several common gaps. Firstly, no studies have identified how treatment modality impacts treatment duration. While many qualitative studies have provided information about the experience of using virtual care, it remains unclear whether treatment length differs. Understanding how treatment modality affects treatment duration is crucial for determining if virtual care is a viable treatment option going forward and can help understand its effectiveness. Furthermore, this information would be beneficial for clinicians and managers in planning resources to meet demand for service and important for clients and families in understanding expected treatment timelines.

Secondly, there is a lack of research on the association between client and system factors and their impact on the association between treatment modality and treatment duration.

Finally, limited studies address the effectiveness of virtual care, especially with a large, representative sample size or a comparator group. There is a dearth of information on child and adolescent mental health-related outcomes, particularly in terms of engagement in care, functioning, or in client-reported outcomes, especially related to virtual care.

These pieces are needed to address the concerns regarding virtual care. This study serves to address the first two gaps in operationalizing a measure of episodes of care for examining service use patterns to understand the impact of treatment modality on treatment duration, as well as how client and system factors influence this relationship, and while not directly measuring effectiveness, may contribute to a better understanding of service effectiveness.

2.8 RATIONALE

Virtual mental health care played an increased and essential role in the delivery of mental health services throughout the COVID-19 pandemic while public health restrictions, including social distancing requirements were in place. Virtual mental health care may continue to play a vital role in a hybrid model of mental health care. Virtual care can be more accessible to some, and clients and their families often prefer virtual care, particularly for avoiding barriers of travel, absence from work, or childcare needs when attending brief check-in appointments, for example (7). However, some clinicians believe it is not as effective as in-person care and therefore requires additional treatment sessions to achieve the goals of therapy. The use of virtual care for balancing access with treatment needs requires a shared decision between clients, caregivers, and clinicians. One aspect for consideration is the length of treatment, and whether it differs by modality of delivery. Therefore, it is essential to quantify and compare episodes of care conducted virtually and in person, while accounting for individual and system level factors that may influence length of episodes.

This study can provide valuable information to clinicians, clients, and their families regarding expected treatment timelines for presenting concerns, acuity, and treatment modality and aid in informing decisions made between clinicians and clients regarding what care will look like moving forward.

2.9 OBJECTIVES

1. Describe episodes of care (numbers of visits within an episode of care, episode length) by treatment modality (virtual vs. in-person vs. hybrid) among children and youth receiving outpatient IWK MHA services between June 30, 2018, and November 2, 2023.
2. Determine whether client characteristics (e.g., age, sex, presenting concern, total HEADS-ED score at intake) influence any associations between treatment modality and episodes of care for fiscal years 2019 to 2022.
3. Determine whether system factors (e.g., CMHA clinic, urgent vs. non-urgent stream, Specific Partnership visits, time period) further contribute to any

associations between treatment modality and episodes of care for fiscal years 2019 to 2022.

CHAPTER 3: METHODS

3.1 SETTING

The IWK MHA Program provides family-centered mental health and addictions care for children and adolescents up to their 19th birthday in Nova Scotia, Canada. Services include inpatient care, psychiatry-led specialty clinics, intensive day treatment services, and outpatient (ambulatory) services offered in Community Mental Health and Addictions clinics, schools, and other community locations. Approximately 430 interdisciplinary health professionals and 16 child and adolescent psychiatrists provide care to nearly 6,000 clients and conduct over 50,000 outpatient appointments and 330 inpatient admissions annually (fiscal year 2021).

Prior to the COVID-19 pandemic, existing telehealth services were rarely utilized by IWK MHA, and were largely provided by a small number of clinicians for clients in geographically distant locations. All IWK MHA services, except for inpatient services, pivoted to a virtual care model at the onset of the public health restrictions introduced in Nova Scotia in March 2020. As the public health restrictions varied with subsequent waves of the pandemic, virtual care continued to be an important treatment modality within the CMHA ambulatory care clinics, while within the more intensive day and overnight services a return to in-person services, with adjustments to meet public health requirements, was required.

3.2 STUDY DESIGN

This study employed a retrospective cohort design using administrative health data collected by the IWK MHA Program. A retrospective study is useful for studying the demographics, clinical characteristics, and health care utilization for a cohort of clients accessing health services over a given time period. These studies may be useful for considering associations between exposures and outcomes; data are collected from individuals with specific characteristics or experiences, and individuals within the study with a specific disease or exposure are compared to those without (67). Retrospective cohort studies look backward in time to examine the relationship between exposure and

outcome, often using previously collected data such as administrative health data. We were interested in describing health service use in terms of episodes of care by treatment modality.

3.3 DATA SOURCES

Administrative health data sources included Meditech registration and Community Wide Scheduling databases held at IWK Health. Abstracted data included client and service information of children and youth who accessed IWK MHA services between April 1, 2018, and January 31, 2024, including client demographic information, clinic location, outpatient appointment dates, visit type (first "Choice" or treatment "Partnership"), modality (virtual or in-person), acuity at intake, and presenting concerns for approximately 11,000 clients. Various data files were used to capture the clinical data, including CMHA Choice, CMHA Partnership, School Mental Health (SMH) Choice, and SMH Partnership.

3.4 VARIABLES (DEPENDENT)

Episodes of Care: In our study, we used episodes of care as the unit of analysis and main outcome of interest. The dependent variable, episodes of care, was defined as periods of service use with fewer than 90 days between care contacts. An episode of care consists of a series of treatment appointments focused on addressing a specific clinical need. While the IWK CMHA program policy considers a visit after a 90-day absence from the service to represent a new episode of care requiring a Choice appointment, long wait times may mean that this is not the case in practice. As such, we conducted sensitivity analyses using a definition of episodes of care as periods of service use with fewer than 180 days between care contacts.

We created episodes of care exclusively using only Partnership visits to enable comparable measures of care contacts for treatment visits. Including Choice visits could skew our understanding of episode length. Clients entering CMHA Partnership services from the inpatient unit (Garron Centre) or Urgent Care Clinics do not have a Choice appointment recorded in CMHA data. Additionally, the study dataset reflected a typical

proportion of clients exiting service following a Choice appointment in a general ambulatory service; approximately 30% of episodes had a duration of one Choice visit (33). Limiting the operationalization of episodes of care to Partnership visits allows us to examine a more cohesive and comparable cohort among those only receiving services from CMHA or SMH.

Episodes of care vary both in terms of numbers of visits and length of the episode (in time units such as days, weeks, or months). As both were of interest, and convey clinically and policy-relevant information, we operationalized episodes of care as: 1) the number of visits within the episode, and 2) the length of the episode in days.

We created the treatment duration (visits) variable by adding all the visits contained within an episode of care.

Based on the creation of the episodes of care, we created the treatment duration (days) variable by calculating the time between the start date and end date of an episode of care.

We also normalized the two outcomes to make the two measures of episode length (days and visits) comparable by creating the ratio of the total number of days within an episode to the total number of visits within an episode. By analyzing this ratio, we can better understand whether the treatment duration in days was affected by intersession wait times (between Partnership visits) indicated by a higher ratio. This may be influenced by overall wait time pressures and appointment availability or perhaps determined in shared clinical decision-making to increase the time between sessions.

3.5 VARIABLES (INDEPENDENT)

Treatment Modality: The main independent variable of interest was the treatment modality. The three treatment modalities were: 1) in-person mental health care, 2) virtual mental health care (delivered by telehealth and Zoom for Healthcare), and 3) hybrid mental health care consisting of both in-person and virtual care visits.

To categorize episodes of care as in-person, virtual, or hybrid, we began by ensuring each visit was categorized as either in-person or virtual based on two variables included in the original dataset: Arrived By and Location of Care. If the visit was in-person, it was marked as either community, walk, or wheelchair in the Arrived By variable or by clinic, school, home, community, Home Bridge, Phoenix, or Shared Care in the Location of Care variable. Conversely, if the visit was virtual, it was indicated by phone or TH (telehealth) in the Arrived By variable or by virtual or telephone in the Location of Care variable. Once an individual visit was classified as either in-person or virtual, the episode modality was determined accordingly. The rules for categorization are below. These rules were devised to ensure that episodes were labeled based on the modality that occurred for a clinically meaningful majority of the time.

Mostly In-Person: Episodes of care with a up to of ten visits were limited to one or fewer virtual visits. For episodes of care with between 11 and 15 visits, a maximum of two virtual visits were permitted. For episodes 16 visits or longer, a maximum of three virtual visits were allowed.

Mostly Virtual: Episodes of care with a maximum of ten visits were limited to one or fewer in-person visits. For episodes of care with between 11 and 15 visits, a maximum of two in-person visits were permitted. For episodes 16 visits or longer, a maximum of three in-person visits were allowed.

Hybrid: Episodes that did not fall into the above categories were considered hybrid. This included episodes of care with exactly two visits, one of each modality.

3.6 CONFOUNDERS AND EFFECT MEASURE MODIFICATION

A confounder is defined as a third variable that distorts the relationship between the exposure and the outcome (68,69). Failing to account for confounders may result in biased estimates of the measures of association between the exposure and the outcome (68,69). Controlling for confounders aids in determining the true effect of the exposure on the outcome.

There are three criteria a variable must meet to be considered a confounder. The first criterion is that the variable must be associated with the exposure, indicating that the confounder is more common in the exposed group than the unexposed group or vice versa. It does not necessarily need to cause or prevent the exposure but needs to be disproportionately distributed between the exposed and unexposed groups. The second criterion is that the variable must cause the outcome. This means there must be a causal link, or a reasonable possibility, that the exposure to the confounder causes the outcome. Finally, the third criterion is that it must not be on a causal pathway (68,69).

To identify confounders within this study, we calculated the crude measure of the association between the exposure variable, treatment modality, and the outcome variable, episodes of care, calculated as the length in days and visits. We then compared the measure of association both before and after adjusting for a potential confounding factor, one at a time. If the difference was greater than 10%, we concluded that confounding was present (69).

Effect measure modification occurs when the magnitude of the effect of an exposure of interest differs depending on the level of a third variable (69). Effect measure modification involves a third variable where the presence of the effect modification is an interesting finding and thus should be highlighted (68). A stratified analysis is used to check for effect modification. Effect modification is detected when the stratum-specific measures of association are different from each other (68).

To identify effect measure modification within this study, we calculated the crude measure of the association between the exposure variable, treatment modality, and the outcome variable, episodes of care, calculated as the length in days and visits. We then calculated stratum-specific measures of association and assessed whether they were different from one another. If the stratum-specific measures were different from one another, the variable was identified as an effect modifier, and the stratum-specific measures of association were reported (68).

Age: The age variable was captured in years and considered the age at the first Partnership appointment of the care episode. Age may be associated with treatment modality as some age groups may have a preference for treatment modality, or clinicians may have a preference on which treatment modality is better suited for the client's age (47). Age may also be associated with the outcome, as different age groups may tend to have longer or shorter periods of service use based on differences in underlying reasons for presentation to mental health services and care seeking behaviours (15,70).

By controlling for age, we can determine whether any differences in episodes of care are primarily due to the treatment modality or if age plays a role in explaining the relationship. We divided the age groups into three categories: 0-11, 12-18, and Over 18, which reflect differences in developmental considerations, clinical presentations, treatments (including likelihood of virtual modality), and other clinical or care seeking factors of relevance. Only 4.5% of episodes contain two different age categories; over half of this is due to clients ageing from the 12-18 to the Over 18 category within the episode. Children in the younger age group might encounter more challenges when adjusting to the virtual treatment modality due to their attention and engagement during the online treatment (41,42). Episodes within the Over 18 category may vary from other groups due to differences in chronicity or presenting concerns, autonomy in care seeking, or lack of available transition services.

Sex: The biological sex of the individual as recorded at the first appointment within an episode. Including sex accounts for potential sex-related differences in clinical presentation or in patterns of service use. Biological sex refers to the physiological and genetic characteristics distinguishing males from females. Gender (the social construct) is not consistently captured in the administrative data over the study period and, as such, was not available for analysis.

The sex of the individual may potentially impact the treatment modality received, as females or males may differ in preference for modality. Moreover, sex may play a role in

episode length, as service use may vary for these groups based on differences in both presentation and care seeking behaviours (15,70).

The sex recorded at the first Partnership visit (i.e., the first visit in an episode of care) was applied to the entire episode of care. Only, 0.23% of episodes have more than one sex reported within an episode.

Presenting Concern: The client's presenting concern, the primary reason for seeking help, was also considered. A client's presenting concern was likely to be associated with treatment modality, as some presenting concerns may require or be better suited for one treatment modality compared to the other. Also, it may be associated with treatment length, as the treatment for the presenting concern will vary, thus episode length will vary.

The presenting concern recorded at the first Partnership visit (i.e., the first visit in an episode of care) was applied to the entire episode of care. Then, based on the presenting concern, it was categorized into one of eleven categories (as below). The presenting concerns categories were based on the CIHI diagnosis code groupings, which are used to categorize episodes of care (71). The presenting concern may vary throughout the episode, and about 15% of episodes contained multiple presenting concern categories. However, we decided to take the first presenting concern as this was most likely the presenting concern that led to the individual seeking care. Therefore, this may be helpful when discussing expected treatment trajectories with future clients entering services.

Presenting Concern Categories:

- **Substance Use and Related Disorders:** Addictions, Substance
- **Mood Disorders:** Mood, Bipolar
- **Anxiety Disorders:** Anxiety
- **Personality Disorders:** Axis II, Personality
- **Eating and Other Feeding Disorders:** Eating
- **Other Mental Health Disorders:** Disruptive Behaviour, Forensic Risk, OCD, Tourette's, Trauma, Psychosis

- **Neurodevelopmental Disorders:** ADHD, ASD
- **Neurocognitive Disorders:** Cognitive, Developmental Delay
- **Trans Health:** Trans Health, Transgender
- **To Be Determined:** To Be Determined (variable labeled as "To Be Determined")
- **Not Available:** Not Available (variable labeled as "Not Available")

Acuity at Intake: Acuity at presentation to CMHA services is measured by the Access Navigators at the point of intake to the services, Central Referral, using the HEADS-ED screening tool. The HEADS-ED is a validated mental health screening tool used to obtain a psychosocial history and guide decision-making regarding client disposition. This tool comprises seven key components: home, education, activities and peers, drugs and alcohol, suicidality, emotions and behaviours, and discharge resources (72,73). These components are rated on a scale of three action levels: no immediate action required, action needed but not immediate, and needs immediate action. A numerical score, either 0, 1, or 2, is assigned to each psychosocial variable. A higher overall HEADS-ED score indicated a need for more intensive or immediate mental health services (73). The HEADS-ED tool is useful in guiding the referral process and discussing the client's clinical needs. It provides a clinical severity and scoring system that helps guide decisions regarding the appropriate next steps (74). HEADS-ED scores are captured routinely by the Access Navigators at the IWK Central Referral service at the point of intake to CMHA.

The HEADS-ED score is likely associated with both treatment modality and duration. Depending on the score, a particular treatment modality may be preferred or deemed more appropriate and may necessitate more or fewer visits. For example, those with a higher overall HEADS-ED score may require in-person mental health care (or in-person risk assessment, particularly for those with a high risk of suicidality) and require more visits to achieve treatment goals.

The HEADS-ED score is captured in the Choice appointment dataset. Additionally, it is important to note that the HEADS-ED score is typically documented in the dataset during the initial scheduled Choice appointment and may not always be carried forward to

subsequent appointments should that appointment be cancelled or missed. As a result, if an individual cancels their first appointment, the HEADS-ED score would be documented at the cancelled or missed appointment, but not necessarily at their first attended appointment. Thus, to ensure we captured the HEADS-ED score associated with a given episode, we took the recorded HEADS-ED score for each study ID and applied it to all Choice appointments that fell within 90 days (or 180 days for the 180-day rule) of that visit for the study ID. Also, as we did not include Choice appointments in our creation of episodes, we ensured that the HEADS-ED score was taken from the Choice appointment within an episode and applied to the entire episode prior to removing Choice appointments from our dataset.

Urgent vs. Non-Urgent Service Use: Following assessment by the Access Navigators at Central Referral, based on the HEADS-ED assessment and other considerations, such as the nature, acuity, and severity of the presenting concern, other available resources, and urgency of need, clients are triaged to either urgent or non-urgent CMHA services, which differ in benchmark wait times for services. Those triaged to urgent services require IWK MHA services within one week of referral**.** This distinction allowed us to account for potential differences in episodes of care due to either client or system factors.

Urgent vs. non-urgent stream was considered as those within the urgent or non-urgent stream may be both more likely to have differences in service use patterns and to receive one treatment modality over the other. Individuals in the urgent stream may be experiencing a crisis, leading to shorter episodes of care, either due to resolution of the crisis or their lack of readiness to engage in formal mental health care at that time. Consequently, they may have a different service utilization pattern than those with less urgent needs, e.g., they may have a greater number of brief care episodes reflecting fewer appointments per episode.

The stream in which the episode occurred is typically indicated at the first Partnership visit. If the first Partnership visit in the dataset was coded as one of the following, the episode was labelled as non-urgent: NON-URG 14, NON-URG 28, NON-URG 60,

NON-URG 90, or Priority Partnership-N. If the first Partnership visit in the dataset was coded as one of the following, the episode was labeled as urgent: URGENT 7 or Priority Partnership-Y.

Specific Partnership Visits: Partnership visits consist of two different types: Core and Specific. Core Partnership visits consist of standard assessment and treatments and comprise most child mental health care. Specific Partnership visits are specialized assessments and treatments tailored to address particular needs and used to augment the Core Partnership visits (30). We considered whether the episode consisted of just Core Partnership visits or both Core and Specific Partnership visits. An episode consisting of both Core and Specific Partnership visits may have a longer duration in numbers of visits, as Specific work occurs alongside the Core work, meaning the episode consisted of multiple types of care (75).

If an episode contained only visits coded as “Core,” it was coded as a "Core" episode. If it contained visits coded as both “Core” and “Specific,” it was coded as a "Core and Specific" episode.

Clinic: Another variable to account for system factors was the clinic in which the episode of care occurred, which served as a proxy for intersession wait times as the CMHA clinics vary in terms of wait times and staffing attrition, which may affect episode lengths. There are four clinic locations within IWK CMHA services – Halifax, Dartmouth, Sackville, and School mental health. Often, clients receive care in clinics near their area of residence; however, this may vary depending on the client's situation. The clinic setting may also be associated with the exposure, as individual clinicians within the clinics may have preferences for treatment modality.

The clinic recorded at the first Partnership visit (i.e., the first visit in an episode of care) was applied to the entire episode of care. Only 2.4% of episodes take place at multiple clinics.

Time Period: The time period during which the episode occurred was another variable considered. The four time periods were captured in fiscal years with Period 1 from April 1, 2019, to March 31, 2020, Period 2 from April 1, 2020, to March 31, 2021, Period 3 from April 1, 2021, to March 31, 2022, and Period 4 from April 1, 2022, to March 31, 2023.

If 50% or more of the visits within an episode of care occurred during a specific period, the episode was labeled as occurring during that period. If exactly 50% of the episode occurred during one period and 50% occurred during another period, the period of the first visit was applied to the entire episode. This occurred in 21% of episodes (n=1,988).

Episodes that predominantly occurred outside of these four time periods, specifically before April 1, 2019, or after March 31, 2023, were excluded from the analysis when adjusting for time period, as the time from June 1, 2018, to March 31, 2019, and from April 1, 2023, to November 2, 2023, did not correspond to full fiscal years.

The time period likely played a role in the choice of modality, or lack thereof, as prior to the pandemic, virtual care was rare, and in contrast, during the beginning of the pandemic, most care was virtual (7). In the early stages of the pandemic, most care was virtual unless there were serious concerns regarding the client's safety, whereas in the later stages of the pandemic there was seemingly more choice between modalities (7,42,47). Moreover, the time period may influence treatment length due to many factors, such as the pandemic and strict public health restrictions affecting clients' access to other supports and services. Additionally, changes in mental health difficulties, especially during the early stages of the pandemic, as indicated by increased reports of symptoms and changes in patterns of service use, could also influence treatment duration (24,25,56,76). Consideration of time period also allowed for capture of any improvements with general experience with technology over time, especially with the widespread adoption of virtual care (42).

Length Categories: We were also interested in describing the characteristics of short, medium, and long episodes. Categorising episode lengths into "short," "medium (below average)", "medium (above average)", and "long" groupings may approximate patterns observed in practice, in which certain groups of clients will have a "short" episode in which clients (with or without their clinician's perspective) determine a lack of need for care (perhaps at that time), a "medium" episode into which many clients in a CAPA model of care will fall within for average treatment needs, and "long" episode for complex clients or for cases in which letting go is not feasible due to lack of alternative care or supports. The short category included episodes with one visit. The medium category was divided into two subcategories: medium (below average), which consisted of episodes with two to eight visits, the average number of visits in an episode within the dataset, and medium (above average), which included episodes with 9 to 18 visits. The long category included episodes with 19 or more visits.

3.7 DATA PREPARATION

3.7.1 DATASET

The administrative dataset included all visits (attended, cancelled, or missed ("no show")) to the CMHA and SMH clinics between April 1, 2018, and January 31, 2024. The dataset also included visits in the Shared Care Clinics, which is a community outreach program that operates in clinics, schools, and community-based services to extend mental health and addictions support to individuals who may not seek care directly from the IWK's MHA program.

The dataset was provided in a set of Excel files; therefore, it was converted to CSV files before importing into Stata (77,78). We retained only the necessary variables to create the final research dataset, which was then formed by combining all the datasets.

3.7.2 DEFINING EPISODES OF CARE COHORT

An episode of care was defined as periods of service use with fewer than 90 days between care contacts. We also conducted a sensitivity analysis of episodes of care with fewer than 180 days between care contacts, to account for the potentially long wait times

that may delay return to service beyond the 90-day policy for requiring a new Choice appointment.

To create episodes of care, we kept only appointments recorded as 'attended.' We sorted the data by study ID and appointment date, then computed the time difference between successive visits for each study ID. Next, we created an additional variable named t_d90 that repeated this process; however, only if the time between visits was less than 90 days. If it exceeded 90 days, t_d90 would be set to zero, indicating a new episode. Essentially, if the time between appointments was greater than 90 days, this was indicated in the data as a new episode of care. This was also done for the other definition of episodes of care, periods of service use with fewer than 180 days between care contacts.

We also established variables to identify visits as the first or last visit within the episode. We calculated the length of an episode, both in days and visits, by adding up the days and visits for the entire episode from start to finish.

3.7.3 EXCLUSIONS TO EPISODES OF CARE

Prior to applying exclusion criteria, we identified 15,583 episodes of care conducted within the CMHA and SMH clinics between April 1, 2018, and January 31, 2024.

We ensured that we did not include partial episodes of care in the analyses; therefore, we only included episodes that began 90 days after the start of the dataset and ended 90 days before the end of the dataset. The dataset began on April 1, 2018, and concluded on January 31, 2024. We then created two cut-off variables, adding 90 days to the start date and subtracting 90 days from the end date. This allowed us to establish our cut-off benchmarks: June 30, 2018, and November 2, 2023, respectively. This was repeated for the 180-day rule, with the cut-off dates of September 28, 2018, and August 4, 2023. If at least one visit within an episode occurred before the start date or after the end date, we removed the entire episode from the dataset for analyses.

We then excluded visits classified as Choice appointments. When restricting the capture to CMHA and SMH Partnership appointments there were 9,567 episodes of care.

We also excluded visits to the Shared Care Clinic that were captured in our dataset. The visits to these clinics and service use patterns can be different from those in the IWK's CMHA and SMH clinics, with many clients referred either for a consult or followed for longer periods of time. Therefore, to accurately compare episodes of care with varying treatment modalities within CMHA, we excluded the visits to the Shared Care Clinics. After applying the Shared Care Clinics exclusion criteria, the dataset consisted of 9,302 episodes of care.

We then removed episodes of care with no identification of treatment modality (i.e., virtual or in-person care). The final cohort consisted of 9,291 episodes of care.

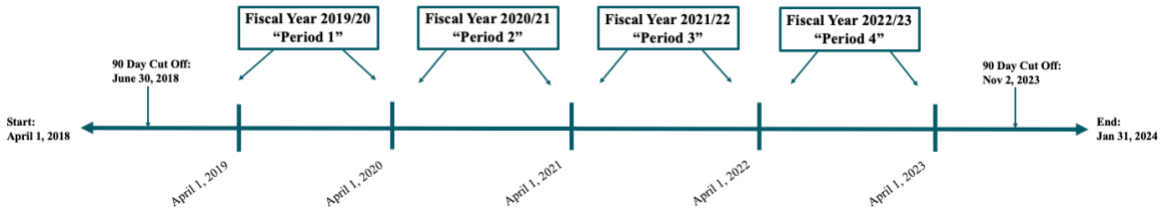

Figure 1. Study Timeline

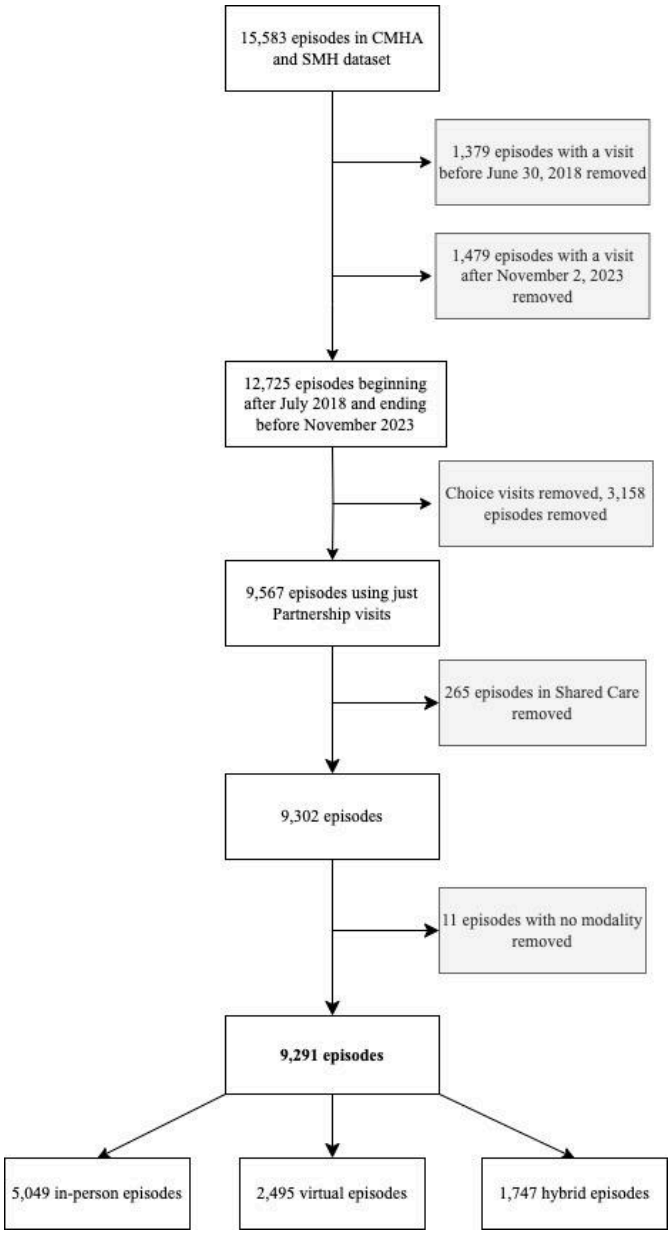

Figure 2. Flow Diagram Outlining the Inclusion and Exclusion Criteria for the Episodes of Care (90-Day Definition) across Community Mental Health and Addictions and School Mental Health Services

3.8 MISSING DATA

The number of episodes with a HEADS-ED score attached is limited, as not everyone receiving community mental health services will receive a HEADS-ED score due to differences in their pathways to the service. Only the subset of clients who enter services through the Central Referral pathway will receive a HEADS-ED score as the tool is used to aid assessment for triage purposes; HEADS-ED scores are not captured for those entering CMHA via inpatient or emergency services, or for internal transfers within CMHA. It is important to note the HEADS-ED data are not considered "missing" for these clients, as they are not triaged at Central Referral. Rather, it is not available or applicable to populations entering services from sources other than Central Referral. It would be inappropriate to impute HEADS-ED scores for those clients not entering via Central Referral. Within our dataset, 96% of clients who entered services through the Central Referral pathway had a HEADS-ED score captured in the dataset.

We described episodes with and without a HEADS-ED score and assessed for differences between these two groups. We conducted sensitivity analyses in the multilevel mixed-effects negative binomial model, zero-inflated negative binomial model, and time-to-event analysis, restricting to only episodes with a HEADS-ED score. We also included the HEADS-ED score variable in the model and compared the estimates to determine how the HEADS-ED score impacted the results.

In terms of identifying urgent and non-urgent streams, when using the decision rule to select the urgent code from the first Partnership visit within an episode, approximately 13% of the episodes were missing an urgent/non-urgent stream flag. Upon examination of the data, it was clear that most of this missing data occurred when an individual had multiple episodes, and the urgent or non-urgent code was only assigned to their first episode. Therefore, we decided to take the urgent or non-urgent code from the first Partnership visit within the dataset and apply it to all their episodes, which reduced the missing data to only 2%. Therefore, for our analysis, we used the decision rule to take the urgent or non-urgent code from the first Partnership visit in the dataset and exclude any episodes with missing data for the stream.

3.9 POWER

For our study to achieve 99% power with a specified effect size of 0.2 visits and a significance level of 0.05, a sample size of 500 episodes was required for the multilevel mixed-effects negative binomial model. The zero-inflated negative binomial model required the same sample size to meet these requirements. Additionally, a sample size of 100 was required for the Cox Proportional Hazards model. Our final sample met these requirements. A power of 99% indicates a 99% chance of detecting a true effect size of 0.2. By selecting this small effect size, we aimed to identify meaningful differences between virtual and in-person episodes of care.

3.10 STATISTICAL ANALYSIS

3.10.1 DESCRIPTIONS OF EPISODES OF CARE

We summarized the client population in the study dataset in terms of mean age, age group, sex, HEADS-ED score (where available), presenting concern at their initial visits, and average number of visits and episodes per client. We summarized episodes of care by urgent/non-urgent stream, Core or Specific Partnership, clinic, treatment modality, time period and average numbers of visits and length in days.

Descriptive analyses include frequencies, means, medians, and proportions as appropriate. We described the characteristics of episodes of care by treatment modality. Additionally, we visualized episode lengths by treatment modality using box plots.

3.10.2 MULTILEVEL MIXED-EFFECTS NEGATIVE BINOMIAL MODEL

To address objectives 2 and 3, we used a multilevel mixed-effects negative binomial model to examine the episode of care outcome in the number of visits. This model was chosen due to the hierarchical structure of the data, with episodes of care nested within individual study IDs and the overdispersed count nature of the outcome.

There were 9,291 episodes nested in 6,444 study IDs. We used multilevel mixed-effects models to deal with the lack of outcome independence. A characteristics of mixed effects model is that they contain both fixed and random effects (79).

Fixed Effects: Fixed effects account for variables that remain constant across observations. Fixed effects enable us to control for the impact of individual characteristics on the outcome (80,81). In this analysis, treatment modality, age, sex, presenting concern, urgent vs. non-urgent stream, Specific Partnership, clinic, and time period were treated as fixed effects. By incorporating fixed effects into our model, we were able to isolate the relationship between treatment modality and episode length while holding constant the episode factors that might confound the relationship.

Random Effects: Random effects account for the variability between subjects. They are often used to represent sources of variation that are not of primary interest; however, they must be accounted for in the analysis (80,81). Random effects account for unobserved heterogeneity, capturing variations in outcomes that cannot be solely explained by the observed variables (80,81).

This analysis used the individual client study ID as a random effect to capture the variability between individuals within the dataset that the fixed effects cannot explain. This allows for the possibility that individuals may be more similar to themselves than to others across episodes, accounting for clustering within the study (79). Although episodes largely occur within individual clinics, we did not treat the clinics as a cluster. Clinics may explain some variation between episodes and individuals, such as residence or socioeconomic status; however, what differentiates the clinics from one another and would contribute to the differences in lengths of episodes is staffing levels and wait times specific to the clinic.

Confounding and effect measure modification for each variable were assessed for each variable. Goodness-of-fit was evaluated using AIC and BIC values. Residuals, including Cook's Distance and DFBETA statistics, were examined to check model assumptions. Sensitivity analyses involved comparing the primary model to a model restricted to episodes with HEADS-ED scores and adjusted for HEADS-ED scores (see Appendix 4).

3.10.3 ZERO-INFLATED NEGATIVE BINOMIAL MODEL

To analyse the normalised data for episodes of care captured as ratios of days to visits, we used zero-inflated negative binomial models. About 17% of the episodes had a ratio of 0 due to episodes consisting of only one visit during one day. Thus, the episode length in days was 0, while the length in visits was 1. A zero-inflated negative binomial model was well-suited to examine this relationship due to its ability to handle overdispersion and excess zeros. A trade-off of this model is that it does not account for any lack of independence between episodes for a given client. However, since approximately 85% of individuals in this study only have one episode of care this may not impact the estimates significantly. We compared the zero-inflated negative binomial model to the multilevel mixed-effects negative binomial model, which does account for the lack of independence. The zero-inflated model resulted in a better fit.

This model contains two components: the count component and the zero-inflated component. The count component models the relationship between treatment modality and the normalized treatment duration. The zero-inflated component accounts for the excess zeros in the data, modeling the factors associated with episodes where the ratio of days to visits is 0 (i.e., episodes consisting of one visit during one day).

We used a step-wise approach to consider the effect of the covariates (age, sex, presenting concern, urgent stream, Specific Partnership, clinic, and time period) on the over-inflated zeros. Additionally, we tested each covariate for confounding and effect measure modification.

3.10.4 TIME-TO-EVENT ANALYSIS

To address objectives 2 and 3, time-to-event analysis methodology was used to model the association between treatment modality and treatment duration (in days). This allowed us to quantify the treatment modality's impact on the length of an episode of care using the Kaplan-Meier non-parametric time-to-event function estimation and Cox Proportional Hazards model to estimate the hazard ratio (HR) associated with modalities while accounting for potential confounding factors.

The starting time was the initiation of treatment. The endpoint within this analysis was the last appointment within an episode of care. We included client and system characteristics that were statistically significantly associated with the outcome and resulted in a statistically significant Wald test result. Further, we kept the modalities that satisfied the proportional hazards assumption.

The assumption that the outcomes are independent was not met, as an individual may have multiple episodes of care. The frailty model aims to address the impact of unmeasured covariates by introducing random effects (82). A shared frailty model is used when observations are clustered into groups or when there are recurrent events, both of which hold true for our data, as an individual may have multiple episodes of care (82).

We used a shared frailty model to examine the association between treatment modality (in-person vs. virtual) and treatment duration in days, controlling for the correlation between episodes belonging to the same individual. The shared frailty model has limitations. In our case, with only a few individuals with multiple episodes of care, it cannot stratify by clinic and Specific Partnership and cannot contain that many strata; thus, we cannot compare the adjusted models of the Cox Proportional Hazards model and the Shared Frailty model. However, it is likely that the estimates would be similar, as about 85% of individuals in this study only have one episode of care; therefore, the clustering would not impact the estimates significantly.

Analyses were conducted using Stata Version 18 and R Studios (78,83)

CHAPTER 4: RESULTS

4.1 DESCRIPTION OF EPISODES OF CARE

The cohort of 9,291 episodes of care between June 30, 2018, and November 2, 2023, represents service use among a study population of 6,444 clients. Table 1 presents the demographic, clinical, service, and health service use characteristics of the study population, which includes clients receiving mental health services within CMHA and SMH. The average age of clients was 13 years (range 3-20 years), and nearly 60% were female. With respect to the clinical characteristics of the full cohort, anxiety disorders were the most common presenting concerns at the first visit (n=1,908 (30%)). The mean HEADS-ED score at the first visit was 6 (range: 0-13). The mean number of visits per person was 11 (range: 1-155) visits. The median number of visits per person was 7.5 (IQR: 3-15). The mean and median number of episodes per person was 1 (range:1-7).

Table 1. Descriptive Statistics of the Full Cohort of Study Population

	Full Cohort of Study Population n=6,444 clients, (100%)
Client Demographic Characteristics	
Age at first Partnership visit in dataset, mean (min-max)	13 (3-20)
Age Category	
0-11	1,675 (26%)
12-18	4,733 (74%)
Over 18	36 (1%)
Sex	
Males	2,653 (41%)
Females	3,791 (59%)
Client Clinical Characteristics	
Presenting Concern, at first visit in dataset	
Substance Use and Related Disorders	245 (4%)
Mood Disorders	954 (15%)
Anxiety Disorders	1,908 (30%)
Personality Disorders	32 (<1%)
Eating and Other Feeding Disorders	108 (2%)
Other Mental Health Disorders	897 (14%)
Neurodevelopmental Disorders	398 (6%)

	Full Cohort of Study Population n=6,444 clients, (100%)
Neurocognitive Disorders	8 (<1%)
Trans Health	175 (3%)
To Be Determined	1,195 (19%)
Not Available	524 (8%)
HEADS-ED Score at first visit, mean (min-max)	6 (0-13) (n= 3,365)
Service Characteristics	
Clinic, at first visit in dataset	
Halifax	1,675 (26%)
Dartmouth	1,587 (25%)
Sackville	1,465 (23%)
School	1,717 (27%)
Time Period of first visit in dataset	
Fiscal Year 2019/20	1,422 (29%)
Fiscal Year 2020/21	1,282 (26%)
Fiscal Year 2021/22	1,224 (25%)
Fiscal Year 2022/23	1,024 (21%)
Health Service Use Characteristics	
Number of visits, mean (min-max)	11 (1-155)
Number of visits, median (IQR)	7.5 (3-15)
Number of episodes per person, mean (min-max)	1 (1-7)
Number of episodes per person, median (IQR)	1 (1-2)

Table 2 presents the demographic, clinical, service, and health service use characteristics of the full cohort of episodes for the 90-day (n=9,291) and 180-day (n=6,612) definitions. Episodes were similar in respect to demographic, clinical, and service characteristics for the two definitions. With respect to the clinical characteristics, anxiety disorders were the most common presenting concerns for the 90-day definition (n= 2,606 (28%)) and the 180-day definition (n=1,870 (28%)). The mean HEADS-ED score was 6 for both definitions. With respect to the service characteristics, a small proportion of the full cohort were identified as episodes in the urgent stream in both the 90-day (n=405 (4%)) and 180-day (n=308 (5%)) definition. A minority of episodes (15%) consisted of both Core and Specific Partnership visits for either definition. With respect to the health service use characteristics, episodes defined using the 180-day rule were longer in terms of both days and visits and were more likely to be classified as hybrid than those

identified using the 90-day rule. For the 90-day definition, the mean episode length was 8 (range: 1-129) visits and 141 (range: 0-1,665) days, while for the 180-day definition, the mean episode length was 9 (range: 1-125) visits and 178 (range: 0-1,655) days. The median episode lengths for the 90- and 180-day rules were 5 (IQR: 2-10) visits and 93 (IQR: 28-196) days, and 6 (IQR: 3-12) visits and 119 (IQR: 42-244) days, respectively.

Table 2. Descriptive Statistics of the Full Cohort of Episodes

	Full Cohort of Episodes (90-day definition) n=9,291 episodes, (100%)	**Full Cohort of Episodes (180-day definition) n=6,612 episodes, (100%)**
Client Demographic Characteristics		
Age of client at first visit in episode, mean (min-max)	14 (3-21)	14 (3-21)
Age Category		
0-11	2,196 (24%)	1,604 (24%)
12-18	7,016 (76%)	4,979 (75%)
Over 18	79 (1%)	29 (<1%)
Sex		
Males	3,813 (41%)	2,666 (40%)
Females	5,477 (59%)	3,946 (60%)
Client Clinical Characteristics		
Presenting Concern at first visit in episode		
Substance Use and Related Disorders	389 (4%)	262 (4%)
Mood Disorders	1,328 (14%)	938 (14%)
Anxiety Disorders	2,606 (28%)	1,870 (28%)
Personality Disorders	65 (1%)	39 (1%)
Eating and Other Feeding Disorders	141 (2%)	122 (2%)
Other Mental Health Disorders	1,286 (14%)	899 (14%)
Neurodevelopmental Disorders	593 (6%)	413 (6%)
Neurocognitive Disorders	14 (<1%)	10 (<1%)
Trans Health	332 (4%)	177 (3%)
To Be Determined	1,883 (20%)	1,391 (21%)
Not Available	654 (7%)	491 (7%)
HEADS-ED Score at first visit in episode, mean (min-max)	6 (0-14) (n=3,917)	6 (1-14) (n=3,763)
Service Characteristics		

	Full Cohort of Episodes (90-day definition) n=9,291 episodes, (100%)	Full Cohort of Episodes (180-day definition) n=6,612 episodes, (100%)
Urgent Stream		
Urgent	405 (4%)	308 (5%)
Non-Urgent	8,624 (96%)	6,099 (95%)
Specific Partnership		
100% Core	7,907 (85%)	5,615 (85%)
Core and Specific	1,384 (15%)	9967(15%)
Clinic		
Halifax	2,443 (26%)	1,694 (26%)
Dartmouth	2,253 (24%)	1,586 (24%)
Sackville	2,024 (22%)	1,490 (23%)
School	2,571 (28%)	1,842 (28%)
Time Period		
Fiscal Year 2019/20	2,181 (27%)	1,622 (26%)
Fiscal Year 2020/21	1,860 (23%)	1,512 (24%)
Fiscal Year 2021/22	1,965 (24%)	1,580 (25%)
Fiscal Year 2022/23	2,133 (26%)	1,519 (24%)
Health Service Use Characteristics		
Episode length, visits, mean (min-max)	8 (1-129)	9 (1-125)
Episode length, visits, median (IQR)	5 (2-10)	6 (3-12)
Episode length, days, mean (min-max)	141 (0-1665)	178 (0-1655)
Episode length, days, median (IQR)	93 (28-196)	119 (42-244)
Episode Modality		
Mostly In-Person	5,049 (54%)	3,192 (48%)
Mostly Virtual	2,495 (27%)	1,857 (28%)
Hybrid	1,747 (19%)	1,563 (24%)

4.1.1 EPISODE MODALITY

Table 3 summarizes the demographic, clinical, service, and health service use characteristics by episode modality (in-person, virtual, and hybrid). With respect to the clinical characteristics, anxiety disorders were the most common presenting concerns among in-person episodes (n=1,468 (29%)) and hybrid episodes (n=525 (30%)). The mean HEADS-ED score was 6 across modalities. Hybrid episodes were the longest (mean episode length of 16 (range: 2-129) visits and 290 (range: 2-1,665) days)

compared to in-person episodes (mean episode length of 6 (range: 1-54) visits and 101 (range: 0-899) days) and virtual episodes (mean episode length of 7 (range: 1-57) visits and 119 (range: 0-988) days).

Table 3. Descriptive Characteristics of In-Person, Virtual, and Hybrid Episodes, 90-Day Definition

	Mostly In-Person n=5,049 episodes, (54%)	**Mostly Virtual n=2,495 episodes, (27%)**	**Hybrid n=1,747 episodes, (19%)**
Client Demographic Characteristics			
Age at first visit in episode, mean (min-max)	14 (3-21)	14 (4-20)	13 (5-20)
Age Category			
0-11	1,111 (22%)	645 (26%)	440 (25%)
12-18	3,886 (78%)	1,826 (74%)	1,304 (75%)
Over 18	52 (1%)	24 (1%)	3 (<1%)
Sex			
Males	2,144 (42%)	1,000 (40%)	669 (38%)
Females	2,904 (58%)	1,495 (60%)	1,078 (62%)
Client Clinical Characteristics			
Presenting Concern			
Substance Use and Related Disorders	247 (5%)	82 (3%)	60 (3%)
Mood Disorders	848 (17%)	244 (10%)	236 (14%)
Anxiety Disorders	1,468 (29%)	613 (25%)	525 (30%)
Personality Disorders	37 (1%)	14 (1%)	14 (1%)
Eating and Other Feeding Disorders	37 (1%)	72 (3%)	32 (2%)
Other Mental Health Disorders	693 (14%)	366 (15%)	227 (13%)
Neurodevelopmental Disorders	331 (7%)	143 (6%)	119 (7%)
Neurocognitive Disorders	12 (<1%)	2 (<1%)	0 (0%)
Trans Health	186 (4%)	95 (4%)	51 (3%)
To Be Determined	754 (15%)	727 (29%)	402 (23%)
Not Available	436 (9%)	137 (5%)	81 (5%)
HEADS-ED Score, mean (min-max)	6 (0-13) (n=2,128)	6 (2-13) (n=1,020)	6 (1-14) (n=769)
Service Characteristics			
Urgent Stream			
Urgent	212 (4%)	106 (4%)	87 (5%)
Non-Urgent	4,738 (96%)	2,276 (96%)	1,610 (95%)

	Mostly In-Person n=5,049 episodes, (54%)	Mostly Virtual n=2,495 episodes, (27%)	Hybrid n=1,747 episodes, (19%)
Specific Partnership			
100% Core	4,506 (89%)	2,077 (83%)	1,324 (76%)
Core and Specific	543 (11%)	418 (17%)	423 (24%)
Clinic			
Halifax	1,302 (26%)	660 (26%)	481 (28%)
Dartmouth	1,159 (23%)	650 (26%)	444 (25%)
Sackville	1,108 (22%)	529 (21%)	387 (22%)
School	1,480 (29%)	656 (26%)	435 (25%)
Time Period			
Fiscal Year 2019/20	1,931 (48%)	8 (<1%)	242 (14%)
Fiscal Year 2020/21	240 (6%)	1,130 (46%)	490 (29%)
Fiscal Year 2021/22	552 (14%)	883 (36%)	530 (31%)
Fiscal Year 2022/23	1,279 (32%)	413 (17%)	441 (26%)
Health Service Use Characteristics			
Episode length, visits, mean (min-max)	6 (1-54)	7 (1-57)	16 (2-129)
Episode length, days, mean (min-max)	101 (0-899)	119 (0-988)	290 (2-1665)

The distribution of lengths of episodes (by numbers of visits and length in days) is demonstrated in the following series of box plots. Figure 3 is a box plot of the episode length in visits by treatment modality. The median in-person episode length in visits was 4 (IQR: 2-7). The median virtual episode length in visits was 5 (IQR: 2-9). The median hybrid episode length in visits was 12 (IQR: 7-22). The hybrid modality was skewed to the right and contained many outliers.

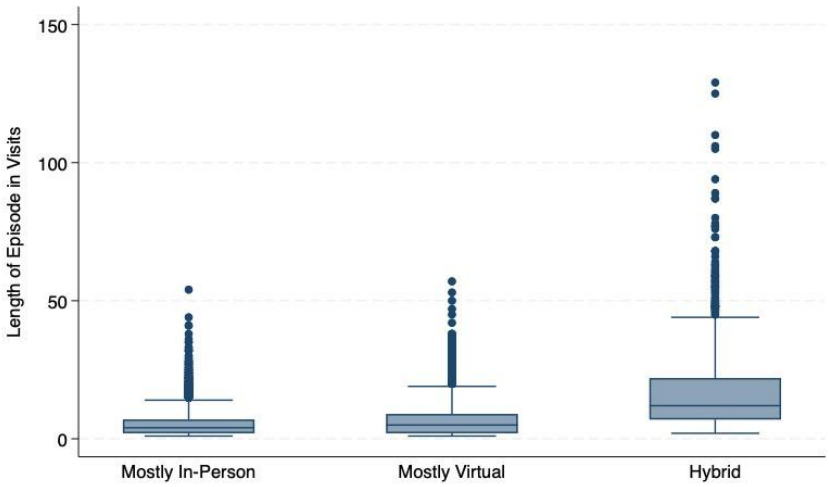

Figure 3. Boxplot of Episode Length, in Visits, by Treatment Modality

Figure 4 is a box plot of the episode length in days by treatment modality. The median in-person episode length in days was 70 (IQR: 14-148). The median virtual episode length in days was 84 (IQR: 22-168). The median hybrid episode length in days was 223 (IQR: 130-392). The hybrid modality was skewed to the right and contained many outliers.

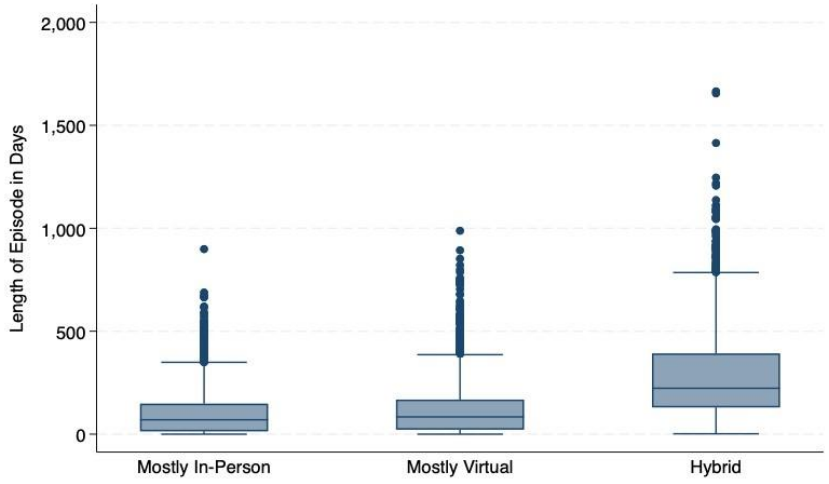

Figure 4. Boxplot of Episode Length, in Days, by Treatment Modality

4.1.2 EPISODES BY TIME PERIOD

Table 4 summarizes the demographic, clinical, service, and health service use characteristics of clients and episodes by time period. With respect to the clinical characteristics, anxiety disorders were the most common presenting concerns in Period 1 (n=611 (28%)) and Period 4 (n=676 (32%)). To Be Determined was the most common presenting concern in Period 2 (n=565 (30%)) and Period 3 (n=601 (31%)). The mean HEADS-ED score was 5 for Period 1 and 6 for Periods 2 to 4. In Period 3, the proportion of episodes identified as urgent was the highest (n=104 (6%)) compared to other periods. The mean episode length in Period 2 (fiscal year 2020/21) was the longest relative to the other periods.

Table 4. Descriptive Characteristics of Episodes by Time Period, 90-Day Definition

	Period 1 (Fiscal Year 2019/20) n=2,181 episodes, (27%)	**Period 2 (Fiscal Year 2020/21) n=1,860 episodes, (23%)**	**Period 3 (Fiscal Year 2021/22) n=1,965 episodes, (24%)**	**Period 4 (Fiscal Year 2022/23) n=2,133 episodes, (26%)**
Client Demographic Characteristics				
Age at first visit in episode, mean (min-max)	14 (3-20)	14 (4-20)	14 (4-20)	14 (4-21)
Age Category				
0-11	549 (25%)	453 (24%)	427 (22%)	494 (23%)
12-18	1,613 (74%)	1,393 (75%)	1,528 (78%)	1,623 (76%)
Over 18	19 (1%)	14 (1%)	10 (1%)	16 (1%)
Sex				
Males	946 (43%)	779 (42%)	729 (37%)	833 (39%)
Females	1,235 (57%)	1,081 (58%)	1,236 (63%)	1,300 (61%)
Client Clinical Characteristics				
Presenting Concern				
Substance Use and Related Disorders	123 (6%)	87 (5%)	56 (3%)	71 (3%)
Mood Disorders	456 (21%)	212 (11%)	238 (12%)	233 (11%)
Anxiety Disorders	611 (28%)	374 (20%)	580 (30%)	676 (32%)
Personality Disorders	11 (1%)	6 (<1%)	15 (1%)	25 (1%)
Eating and Other	24 (1%)	34 (2%)	37 (2%)	35 (2%)

	Period 1 (Fiscal Year 2019/20) n=2,181 episodes, (27%)	Period 2 (Fiscal Year 2020/21) n=1,860 episodes, (23%)	Period 3 (Fiscal Year 2021/22) n=1,965 episodes, (24%)	Period 4 (Fiscal Year 2022/23) n=2,133 episodes, (26%)
Feeding Disorders				
Other Mental Health Disorders	336 (15%)	239 (13%)	266 (14%)	284 (13%)
Neurodevelopmental Disorders	165 (8%)	74 (4%)	107 (5%)	169 (8%)
Neurocognitive Disorders	4 (<1%)	1 (<1%)	3 (<1%)	5 (<1%)
Trans Health	94 (4%)	73 (4%)	58 (3%)	57 (3%)
To Be Determined	11 (1%)	565 (30%)	601 (31%)	572 (27%)
Not Available	346 (16%)	195 (10%)	4 (<1%)	6 (<1%)
HEADS-ED Score, mean (min-max)	5 (2-13) (n=982)	6 (2-14) (n=841)	6 (2-13) (n=841)	6 (0-12) (n=850)
Service Characteristics				
Urgent Stream				
Urgent	84 (4%)	64 (4%)	104 (6%)	100 (5%)
Non-Urgent	2,097 (96%)	1,741 (96%)	1,772 (94%)	1,951 (95%)
Specific Partnership				
100% Core	1,937 (89%)	1,526 (82%)	1,655 (84%)	1,748 (82%)
Core and Specific	244 (11%)	334 (18%)	310 (16%)	385 (18%)
Clinic				
Halifax	591 (27%)	498 (27%)	466 (24%)	572 (27%)
Dartmouth	553 (25%)	443 (24%)	482 (25%)	504 (24%)
Sackville	517 (24%)	382 (21%)	401 (20%)	460 (22%)
School	520 (24%)	537 (29%)	616 (31%)	597 (28%)
Health Service Use Characteristics				
Episode length, visits, mean (min-max)	8 (1-129)	10 (1-87)	8 (1-94)	8 (1-63)
Episode length, days, mean (min-max)	160 (0-1665)	170 (0-1056)	148 (0-1095)	141 (0-765)
Episode Modality				
Mostly In-Person	1,931 (89%)	240 (13%)	552 (28%)	1,279 (60%)
Mostly Virtual	8 (<1%)	1,130 (61%)	883 (45%)	413 (19%)
Hybrid	242 (11%)	490 (26%)	530 (27%)	441 (21%)

Table 5 summarizes the episode length by treatment modality during each time period, in terms of number of visits. The mostly in-person treatment modality had the highest mean number of visits during Period 4 (mean=7). The mostly virtual treatment modality had the highest mean number of visits during Periods 2 and 3 (mean=7). Table 6 summarizes the episode length by treatment modality during each time period, in terms of number of days. The mostly in-person treatment modality had the highest mean number of days during Period 1 (mean=123). The mostly virtual treatment modality had the highest mean number of days during Period 3 (mean=126).

Table 5. Episode Length in Visits by Treatment Modality, In Each Time Period, 90-Day Definition

	Episode Length, Visits			
	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
Mostly In-Person				
Mean (Min-Max)	6 (1-41)	4 (1-35)	5 (1-54)	7 (1-44)
Median (IQR)	5 (2-9)	3 (2-5)	4 (2-7)	5 (2-9)
n	1,931	240	552	1,279
Mostly Virtual				
Mean (Min-Max)	5 (1-26)	7 (1-57)	7 (1-50)	6 (1-36)
Median (IQR)	2 (1-3.5)	5 (3-9)	5 (2-9)	4 (2-8)
n	8	1,130	883	413
Hybrid				
Mean (Min-Max)	24 (2-129)	19 (2-87)	14 (2-94)	14 (2-63)
Median (IQR)	18 (9-33)	15 (9-26)	10 (7-18)	10 (7-17)
n	242	490	530	441
All Modalities				
Mean (Min-Max)	8 (1-129)	10 (1-87)	8 (1-94)	8 (1-63)
Median (IQR)	5 (2-10)	6 (3-13)	6 (2-11)	6 (3-11)
n	2,181	1,860	1,965	2,133

Table 6. Episode Length in Days by Treatment Modality, In Each Time Period, 90-Day Definition

	Episode Length, Days			
	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
Mostly In-Person				
Mean (Min-Max)	123 (0-670)	69 (0-530)	94 (0-899)	122 (0-688)
Median (IQR)	91 (25-185)	41 (7-91)	57 (14-131)	94 (29-180)
n	1,931	240	552	1,279
Mostly Virtual				
Mean (Min-Max)	111 (0-753)	122 (0-988)	126 (0-852)	107 (0-548)
Median (IQR)	13.5 (0-55)	91 (29-171)	82 (21-175)	77 (18-155)
n	8	1,130	883	413
Hybrid				
Mean (Min-Max)	461 (17-1665)	331 (6-1056)	241 (2-1095)	226 (4-765)
Median (IQR)	364 (176-678)	278 (154-461)	196 (119-328)	193 (119-305)
n	242	490	530	441
All Modalities				
Mean (Min-Max)	160 (0-1665)	170 (0-1056)	148 (0-1095)	141 (0-765)
Median (IQR)	103 (33-221)	114 (41-232)	104 (33-209)	110 (37-204)
n	2,181	1,860	1,965	2,133

4.1.3 EPISODE LENGTH BY CLINIC

Table 7 summarizes the demographic, clinical, service, and health service use characteristics for each clinic. Episodes among the clinics were quite similar in terms of the client demographic and clinical characteristics. With respect to the clinical characteristics, anxiety disorders were the most common presenting concerns in the Dartmouth (n=796 (35%)) and Halifax (n=662 (27%)) clinics. To Be Determined was the most common presenting concern in the Sackville (n=513 (25%)) and School (n=804 (31%)) clinics. The mean HEADS-ED score was 6 for all clinics except for the Sackville clinic (mean=5).

Table 7. Descriptive Characteristics of Episodes by Clinic, 90-Day Definition

	Dartmouth n=2,254 episodes, (24%)	**Halifax n=2,443 episodes, (26%)**	**Sackville n=2,022 episodes, (22%)**	**School n=2,572 episodes, (28%)**
Client Demographic Characteristics				
Age at first visit in episode, mean (min-max)	13 (3-21)	13 (3-20)	13 (3-19)	15 (4-20)
Age Category				
0-11	715 (32%)	707 (29%)	640 (32%)	134 (5%)
12-18	1,520 (67%)	1,712 (70%)	1,376 (68%)	2,408 (94%)
Over 18	19 (1%)	24 (1%)	6 (<1%)	30 (1%)
Sex				
Males	972 (43%)	1,115 (46%)	833 (41%)	893 (35%)
Females	1,282 (57%)	1,327 (54%)	1,189 (59%)	1,679 (65%)
Client Clinical Characteristics				
Presenting Concern				
Substance Use and Related Disorders	124 (6%)	180 (7%)	38 (2%)	46 (2%)
Mood Disorders	368 (16%)	288 (12%)	238 (12%)	434 (17%)
Anxiety Disorders	796 (35%)	662 (27%)	493 (24%)	656 (26%)
Personality Disorders	14 (1%)	22 (1%)	19 (1%)	10 (<1%)
Eating and Other Feeding Disorders	30 (1%)	16 (1%)	55 (3%)	40 (2%)
Other Mental Health Disorders	564 (25%)	318 (13%)	286 (14%)	119 (5%)
Neurodevelopmental Disorders	196 (9%)	239 (10%)	103 (5%)	55 (2%)
Neurocognitive Disorders	5 (<1%)	5 (<1%)	2 (<1%)	2 (<1%)
Trans Health	48 (2%)	89 (4%)	31 (2%)	164 (6%)
To Be Determined	102 (5%)	464 (19%)	513 (25%)	804 (31%)
Not Available	7 (<1%)	160 (7%)	244 (12%)	242 (9%)
HEADS-ED Score, mean (min-max)	6 (2-13) (n=850)	6 (2-13) (n=849)	5 (1-14) (n=942)	6 (0-13) (n=1,276)
Service Characteristics				
Urgent Stream				
Urgent	180 (8%)	130 (6%)	64 (3%)	31 (1%)
Non-Urgent	2,025 (92%)	2,228 (94%)	1,894 (97%)	2,479 (99%)
Specific Partnership				
100% Core	1,780 (79%)	2,107 (86%)	1,768 (87%)	2,252 (88%)

	Dartmouth n=2,254 episodes, (24%)	Halifax n=2,443 episodes, (26%)	Sackville n=2,022 episodes, (22%)	School n=2,572 episodes, (28%)
Core and Specific	474 (21%)	336 (14%)	254 (13%)	320 (12%)
Health Service Use Characteristics				
Episode length, visits, mean (min-max)	8 (1-129)	8 (1-110)	9 (1-105)	7 (1-125)
Episode length, days, mean (min-max)	149 (0-1207)	135 (0-1414)	154 (0-1246)	130 (0-1665)
Episode Modality				
Mostly In-Person	1,159 (51%)	1,302 (53%)	1,108 (55%)	1,480 (58%)
Mostly Virtual	651 (29%)	660 (27%)	528 (26%)	656 (26%)
Hybrid	444 (20%)	481 (20%)	386 (19%)	436 (17%)

Table 8 summarizes the episode length by treatment modality in each clinic, in terms of number of visits. Episodes that took place within the Sackville clinic had the highest mean and median number of visits for both the mostly in-person and mostly virtual modalities.

Table 8. Episode Length in Visits by Treatment Modality, by Clinic, 90-Day Definition

	Episode Length, Visits			
	Dartmouth	**Halifax**	**Sackville**	**School**
Mostly In-Person				
Mean (Min-Max)	5 (1-54)	5 (1-41)	6 (1-35)	5 (1-44)
Median (IQR)	4 (2-7)	4 (2-7)	5 (2.5-9)	3 (2-7)
n	1,159	1,302	1,108	1,480
Mostly Virtual				
Mean (Min-Max)	7 (1-45)	7 (1-53)	8 (1-57)	6 (1-50)
Median (IQR)	5 (3-9)	4 (2-8.5)	6 (3-10)	4 (2-8)
n	650	660	529	656
Hybrid				
Mean (Min-Max)	17 (2-129)	15 (2-110)	17 (2-105)	17 (2-125)
Median (IQR)	12 (7-22)	11 (7-20)	12 (7-21)	13 (7-23)
n	444	481	387	435
All Modalities				
Mean (Min-Max)	9 (1-129)	8 (1-110)	9 (1-105)	7 (1-125)
Median (IQR)	5 (2-10)	5 (2-10)	6 (3-11)	4 (2-9)
n	2,253	2,443	2,024	2,571

Table 9 summarizes the episode length by treatment modality in each clinic, in terms of number of days. Episodes within the Sackville clinic had the highest mean and median number of days for the mostly in-person modality, whereas episodes within the Dartmouth clinic had the highest mean and median number of days for the mostly virtual modality.

Table 9. Episode Length in Days by Treatment Modality, by Clinic, 90-Day Definition

	Episode Length, Days			
	Dartmouth	**Halifax**	**Sackville**	**School**
Mostly In-Person				
Mean (Min-Max)	103 (0-899)	95 (0-592)	117 (0-664)	92 (0-688)
Median (IQR)	70 (10-154)	63 (10-140)	86 (31-171)	56.5 (11-133.5)
n	1,159	1,302	1,108	1,480
Mostly Virtual				
Mean (Min-Max)	129 (0-738)	122 (0-988)	126 (0-753)	101 (0-799)
Median (IQR)	98 (32-185)	81 (21-167.5)	91 (30-183)	64 (14-146)
n	650	660	529	656
Hybrid				
Mean (Min-Max)	299 (4-1207)	261 (8-1414)	297 (4-1246)	303 (2-1665)
Median (IQR)	245.5 (133-405.5)	201 (124-344)	226 (133-391)	232 (124-419)
n	444	481	387	435
All Modalities				
Mean (Min-Max)	149 (0-1207)	135 (0-1414)	154 (0-1246)	105 (0-1665)
Median (IQR)	101 (30-210)	89 (24-189)	112 (41.5-213)	78 (18-178)
n	2,253	2,443	2,024	2,571

4.1.4 CATEGORISING EPISODE LENGTH

Table 10 summarizes the demographic, clinical, service, and health service use characteristics by groupings of episode lengths. With respect to the clinical characteristics, anxiety disorders were the most common presenting concern among all groups. The long and the medium (above average) episode categories had the highest proportion of urgent episodes (5%) compared to the short (4%), medium (below average) (4%) categories. Moreover, 45% of the episodes in the long category consist of both Core and Specific Partnership visits (n=379). The in-person modality was the most common

modality for the short (n=1,082 (70%)), medium (below average) (n=2,933 (60%)) and medium (above average) (n=885 (44%)) categories. The most common modality for the long category was hybrid (n=535 (64%)).

Table 10. Descriptive Characteristics of Short, Medium (Below and Above Average), and Long Episodes, 90-Day Definition

	Short Episodes (1 visit) n=1,542 (17%)	**Medium (Below Average) Episodes (2-8 visits) n= 4,886 (53%)**	**Medium (Above Average) Episodes (9-18 visits) n= 2,027 (22%)**	**Long Episodes (19+ visits) n=836 (9%)**
Demographic Characteristics				
Age at first visit in episode, mean (min-max)	14 (3-21)	14 (3-20)	14 (3-20)	14 (4-18)
Age Category				
0-11	349 (23%)	1,215 (25%)	459 (23%)	173 (21%)
12-18	1,154 (75%)	3,633 (74%)	1,566 (77%)	663 (79%)
Over 18	39 (3%)	38 (1%)	2 (<1%)	0 (0%)
Sex				
Males	686 (44%)	2,091 (43%)	750 (37%)	286 (34%)
Females	856 (56%)	2,794 (57%)	1,277 (63%)	550 (66%)
Clinical Characteristics				
Presenting Concern				
Substance Use and Related Disorders	85 (6%)	220 (5%)	57 (3%)	27 (3%)
Mood Disorders	215 (14%)	689 (14%)	307 (15%)	117 (14%)
Anxiety Disorders	395 (26%)	1,345 (28%)	619 (31%)	247 (30%)
Personality Disorders	11 (1%)	39 (1%)	9 (<1%)	6 (1%)
Eating and Other Feeding Disorders	8 (1%)	42 (1%)	56 (3%)	35 (4%)
Other Mental Health Disorders	212 (14%)	692 (14%)	256 (13%)	126 (15%)
Neurodevelopmental Disorders	94 (6%)	338 (7%)	112 (6%)	49 (6%)
Neurocognitive Disorders	5 (<1%)	7 (<1%)	1 (<1%)	1 (<1%)
Trans Health	84 (5%)	174 (4%)	40 (2%)	34 (4%)
To Be Determined	315 (20%)	988 (20%)	440 (22%)	140 (17%)
Not Available	118 (8%)	352 (7%)	130 (6%)	54 (6%)

	Short Episodes (1 visit) n=1,542 (17%)	Medium (Below Average) Episodes (2-8 visits) n= 4,886 (53%)	Medium (Above Average) Episodes (9-18 visits) n= 2,027 (22%)	Long Episodes (19+ visits) n=836 (9%)
HEADS-ED Score, mean (min-max)	6 (0-12) (n=473)	6 (1-13) (n=2,177)	6 (2-13) (n=933)	6 (2-14) (n=334)
Service Characteristics				
Urgent Stream				
Urgent	55 (4%)	213 (4%)	93 (5%)	44 (5%)
Non-Urgent	1,430 (96%)	4,541 (96%)	1,880 (95%)	773 (95%)
Specific Partnership				
100% Core	1,376 (89%)	4,392 (90%)	1,682 (83%)	457 (55%)
Core and Specific	166 (11%)	494 (10%)	345 (17%)	379 (45%)
Clinic				
Halifax	430 (28%)	1,293 (26%)	501 (25%)	219 (26%)
Dartmouth	382 (25%)	1,167 (24%)	491 (24%)	213 (25%)
Sackville	240 (16%)	1,055 (22%)	547 (27%)	182 (22%)
School	490 (32%)	1,371 (28%)	488 (24%)	222 (27%)
Time Period				
Fiscal Year 2019/20	346 (30%)	1,132 (27%)	514 (26%)	189 (23%)
Fiscal Year 2020/21	231 (20%)	896 (21%)	462 (23%)	271 (32%)
Fiscal Year 2021/22	290 (25%)	1,021 (24%)	461 (23%)	193 (23%)
Fiscal Year 2022/23	275 (24%)	1,144 (27%)	533 (27%)	181 (22%)
Health Service Use				
Episode Modality				
Mostly In-Person	1,082 (70%)	2,933 (60%)	885 (44%)	149 (18%)
Mostly Virtual	460 (30%)	1,374 (28%)	509 (25%)	152 (18%)
Hybrid	0 (0%)	579 (12%)	633 (31%)	535 (64%)

4.1.5 RATIO OF DAYS TO VISITS

Table 11 presents the ratio of days to visits for each time period by treatment modality. For all modalities, the mean ratio of days to visits was the highest in Period 1 (16.76 (range: 0-52.75) and the smallest in Period 2 (15.19 (range:0-45.67)). The in-person modality followed a similar pattern, where the ratio was highest during Period 1 (16.24 (range:0-52.75)) and lowest in Period 2 (11.86 (range: 0-45.67)). For the virtual modality,

the period with the lowest ratio, excluding Period 1 as there were very few virtual episodes within this time period, was Period 2 (14.57 (range: 0-44)) and Period 4 had the highest ratio (14.86 (range: 0-48.2)).

Table 11. Ratio of Days to Visits per Episode, by Time Period and Treatment Modality 90-Day Definition

Days/Visits				
	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
Mostly In-Person				
Mean (Min–Max)	16.24 (0–52.75)	11.86 (0–45.67)	14.04 (0–45.67)	15.73 (0–47.67)
Median (IQR)	17 (9–23.18)	11 (3.5–17.65)	14 (6.75–21.25)	16.33 (10.25–22.17)
n	1,931	240	552	1,277
Mostly Virtual				
Mean (Min–Max)	8.51 (0–28.96)	14.57 (0–44)	14.70 (0–44.33)	14.86 (0–48.2)
Median (IQR)	4.5 (0–15.04)	15.08 (9.33–20.64)	15.4 (8–21)	15.22 (7–22)
n	8	1,129	882	413
Hybrid				
Mean (Min–Max)	21.26 (8.12–44)	18.27 (3–42.5)	18.59 (1–46.5)	17.69 (2–43)
Median (IQR)	20.95 (17.5–24.52)	17.84 (14.24–21.42)	17.88 (14.54–21.93)	17.15 (13.03–21.76)
n	242	488	530	440
All Modalities				
Mean (Min–Max)	16.76 (0–52.75)	15.19 (0–45.67)	15.56 (0-46.5)	15.97 (0–48.2)
Median (IQR)	17.53 (10.5–23.47)	15.89 (10.25–20.75)	16.1 (10–21.41)	16.45 (10.5–22)
n	2,181	1,857	1,964	2,130

Figure 5 presents histograms of the days-to-visit ratio for each time period.

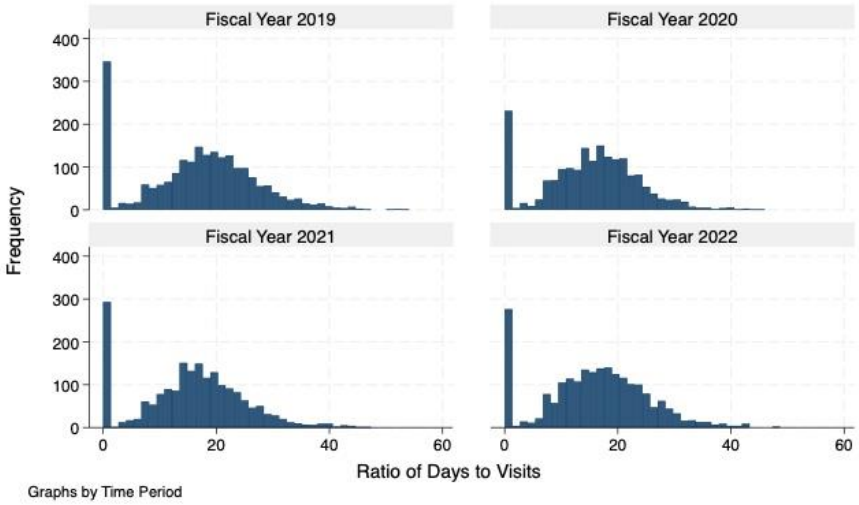

Figure 5. Histogram of Days/Visits, by Time Period

4.1.6 COMPARISON BETWEEN EPISODES WITH AND WITHOUT A HEADS-ED SCORE

Table 12 displays the descriptive statistics results of the episodes with and without a HEADS-ED score. The variables that demonstrated a difference between the two groups were the urgent stream, Specific Partnership, and clinic variables.

Table 12. Descriptive Statistics of Episodes With and Without a HEADS-ED Score, 90-Day Definition

	Episodes Without HEADS-ED Score n=5,374 episodes, (58%)	**Episodes With HEADS-ED Score n=3,917 episodes, (42%)**
Client Demographic Characteristics		
Age of client at first visit in episode, mean (min-max)	14 (3-21)	13 (3-19)
Age Category		
0-11	1,080 (20%)	1,116 (28%)
12-18	4,220 (79%)	2,796 (71%)
Over 18	74 (1%)	5 (<1%)
Sex		
Males	2,171 (40%)	1,642 (42%)
Females	3,202 (60%)	2,275 (58%)
Client Clinical Characteristics		

	Episodes Without HEADS-ED Score n=5,374 episodes, (58%)	Episodes With HEADS-ED Score n=3,917 episodes, (42%)
Presenting Concern at first visit in episode		
Substance Use and Related Disorders	252 (5%)	136 (3%)
Mood Disorders	847 (16%)	481 (12%)
Anxiety Disorders	1,395 (26%)	1,212 (31%)
Personality Disorders	51 (1%)	14 (<1%)
Eating and Other Feeding Disorders	125 (2%)	16 (<1%)
Other Mental Health Disorders	763 (14%)	524 (13%)
Neurodevelopmental Disorders	300 (6%)	293 (7%)
Neurocognitive Disorders	8 (<1%)	6 (<1%)
Trans Health	308 (6%)	24 (1%)
To Be Determined	997 (19%)	886 (23%)
Not Available	328 (6%)	325 (8%)
Service Characteristics		
Urgent Stream		
Urgent	343 (7%)	62 (2%)
Non-Urgent	4,814 (93%)	3,812 (98%)
Specific Partnership		
100% Core	4,332 (81%)	3,575 (91%)
Core and Specific	1,042 (19%)	342 (9%)
Clinic		
Halifax	1,594 (30%)	849 (22%)
Dartmouth	1,404 (26%)	850 (22%)
Sackville	1,080 (20%)	942 (24%)
School	1,296 (24%)	1,276 (33%)
Time Period		
Fiscal Year 2019/20	1,199 (26%)	982 (28%)
Fiscal Year 2020/21	1,019 (22%)	841 (24%)
Fiscal Year 2021/22	1,124 (24%)	841 (24%)
Fiscal Year 2022/23	1,283 (28%)	850 (24%)
Health Service Use Characteristics		
Episode length, visits, mean (min-max)	8 (1-129)	8 (1-94)
Episode length, visits, median (IQR)	5 (2-10)	6 (3-10)
Episode length, days, mean (min-max)	137 (0-1665)	147 (0-1218)
Episode length, days, median (IQR)	84 (18-190)	106 (42-202)
Episode Modality		
Mostly In-Person	2,921 (54%)	2,128 (54%)

	Episodes Without HEADS-ED Score n=5,374 episodes, (58%)	Episodes With HEADS-ED Score n=3,917 episodes, (42%)
Mostly Virtual	1,475 (27%)	1,020 (26%)
Hybrid	978 (18%)	769 (20%)

4.1.7 DESCRIPTION OF EPISODES OF CARE (180-DAY RULE)

As a sensitivity analysis, we examined the descriptive statistics using the 180-day definition (see Appendix 3). However, we found no major differences between the two rules, therefore, moving forward, we used the 90-day rule for our modeling.

4.2 MULTILEVEL MIXED-EFFECTS MODEL RESULTS

The results of the crude multilevel mixed-effects negative binomial model, which included study ID as a random effect, are shown in Table 13. The incidence-rate ratio (IRR) for the virtual treatment modality compared to the in-person treatment modality was 1.196 (CI: 1.146, 1.248). The incidence-rate ratio for the hybrid treatment modality compared to the in-person treatment modality was 2.917 (CI: 2.789, 3.052). Both of the incidence-rate ratios were significant, as the p-values were less than 0.01, and the 95% confidence intervals did not cross 1.

Table 13. Crude Multilevel Mixed-Effects Negative Binomial Model for Treatment Duration in Visits

	IRR	95% Confidence Interval
Treatment Modality		
Mostly In-Person (Reference)		
Mostly Virtual	1.196 **	1.146, 1.248
Hybrid	2.917 **	2.789, 3.052
Constant	5.169 **	5.035, 5.308
Variance Between Individuals	0.169	0.147, 0.193

Note: * indicates p-value<0.05 ** indicates p-value<0.01

The results of the adjusted multilevel mixed-effects negative binomial model are shown in Table 14. We adjusted for age, sex, presenting concern, urgent stream, Specific Partnership, and clinic. We also restricted to episodes with between 2 to 24 visits and

stratified by time period. Additionally, we treated the study ID as a random effect. Among all the periods, Period 2 had the highest IRR for both virtual (IRR = 1.43; CI: 1.28, 1.60; p<0.01) and hybrid (IRR = 2.23; CI: 1.98, 2.51; p<0.01) episodes as compared to in-person episodes.

Table 14. Adjusted Multilevel Mixed-Effects Negative Binomial Model for Treatment Duration in Visits

	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)
Treatment Modality				
Mostly In-Person (Reference)				
Mostly Virtual	0.49 (0.21, 1.16)	1.43 (1.28, 1.60) **	1.20 (1.10, 1.30) **	0.87 (0.81, 0.95) **
Hybrid	1.54 (1.39, 1.70) **	2.23 (1.98, 2.51) **	1.74 (1.60, 1.90) **	1.38 (1.28, 1.48) **
Age				
0-11 (Reference)				
12-18	1.12 (1.03, 1.22) *	1.05 (0.96, 1.14)	1.09 (1.01, 1.19) *	0.99 (0.92, 1.07)
Over 18	0.72 (0.44, 1.17)	0.37 (0.20, 0.69) **	0.80 (0.49, 1.32)	0.67 (0.39, 1.15)
Sex				
M (Reference)				
F	1.01 (0.95, 1.09)	1.11 (1.03, 1.18) *	1.09 (1.02, 1.17)	1.10 (1.03, 1.17) **
Presenting Concern				
Substance Use and Related Disorders (Reference)				
Mood Disorders	1.33 (1.13, 1.55) **	1.05 (0.87, 1.27)	1.59 (1.26, 2.02) **	1.33 (1.10, 1.60) **
Anxiety Disorders	1.35 (1.16, 1.58) **	1.12 (0.93, 1.34)	1.48 (1.18, 1.86) **	1.39 (1.16, 1.66) **
Personality Disorders	1.32 (0.85, 2.04)	0.92 (0.53, 1.58)	1.48 (0.92, 2.38)	1.14 (0.83, 1.56)
Eating and Other Feeding Disorders	1.73 (1.27, 2.36) **	1.21 (0.91, 1.62)	1.51 (1.09, 2.08)	1.62 (1.19, 2.21) **

	Period 1 (Fiscal Year 2019/20)	Period 2 (Fiscal Year 2020/21)	Period 3 (Fiscal Year 2021/22)	Period 4 (Fiscal Year 2022/23)
	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)
Other Mental Health Disorders	1.26 (1.06, 1.49) **	1.08 (0.90, 1.30)	1.42 (1.13, 1.80) *	1.21 (1.00, 1.46) *
Neurodevelopmental Disorders	1.16 (0.97, 1.40)	1.10 (0.87, 1.39)	1.39 (1.07, 1.79) *	1.28 (1.05, 1.56) **
Neurocognitive Disorders	1.06 (0.41, 2.77)	1.65 (0.53, 5.08)	1.38 (0.53, 3.59)	1.38 (0.67, 2.86)
Trans Health	1.04 (0.83, 1.32)	0.72 (0.57, 0.91) **	1.00 (0.73, 1.36)	0.87 (0.66, 1.14)
To Be Determined	1.04 (0.62, 1.74)	0.92 (0.77, 1.10)	1.61 (1.28, 2.02) **	1.24 (1.03, 1.48) *
Not Available	1.16 (0.99, 1.37)	1.09 (0.90, 1.33)	1.41 (0.74, 2.70)	0.94 (0.50, 1.76)
Urgent Stream				
Urgent (Reference)				
Non-Urgent	0.95 (0.80, 1.13)	1.22 (1.01, 1.46) *	0.87 (0.75, 1.00) *	0.88 (0.77, 1.00)
Specific Partnership				
Core (Reference)				
Core and Specific	1.35 (1.19, 1.53) **	1.44 (1.30, 1.61) **	1.47 (1.32, 1.63) **	1.54 (1.42, 1.68) **
Clinic				
Dartmouth (Reference)				
Halifax	1.00 (0.92, 1.10)	0.97 (0.88, 1.07)	1.01 (0.92, 1.11)	1.07 (0.98, 1.16)
Sackville	1.16 (1.06, 1.27) **	1.10 (0.99, 1.22)	1.07 (0.97, 1.18)	1.12 (1.03, 1.23) *
School	1.00 (0.91, 1.10)	0.95 (0.86, 1.05)	0.95 (0.85, 1.05)	1.05 (0.96, 1.15)
Constant	4.86 (3.84, 6.16) **	3.47 (2.65, 4.55) **	3.60 (2.75, 4.71) **	5.19 (4.15, 6.50) **
Variance Between Individuals	0.11 (0.07, 0.18)	0.14 (0.09, 0.21)	0.14 (0.09, 0.21)	0.08 (0.05, 0.15)

Note: * indicates p-value<0.05 ** indicates p-value<0.01

4.3 ZERO-INFLATED NEGATIVE BINOMIAL MODEL RESULTS

The results of the adjusted zero-inflated negative binomial model are shown in Table 15. We adjusted for age, presenting concern, urgent stream, Specific Partnership, clinic, and time period. The IRR for the virtual modality compared to the in-person modality was

1.01 (CI: 0.98, 1.04); however, this result was not statistically significant. The IRR of the normalized length of episodes (days/visits) categorized as delivered using a hybrid modality compared to the in-person modality was small but statistically significant, at 1.04 (CI: 1.02, 1.07; $p<0.01$). In the zero-inflation component of the zero-inflated negative binomial model, the coefficient for the virtual treatment modality was 0.38 (CI: 0.25, 0.52). This indicates that virtual episodes of care were more likely to have a ratio of 0 (in other words, one visit in one day) compared to in-person episodes of care.

Table 15. Zero-Inflated Negative Binomial Model for Ratio of Days to Visits

	IRR	95% Confidence Interval
Treatment Modality		
Mostly In-Person (Reference)		
Mostly Virtual	1.01	0.98, 1.04
Hybrid	1.04 **	1.02, 1.07
Age		
0-11 (Reference)		
12-18	0.96 **	0.94, 0.98
Over 18	0.94	0.82, 1.09
Presenting Concern		
Substance Use and Related Disorders (Reference)		
Mood Disorders	1.04	0.98, 1.09
Anxiety Disorders	1.05	1.00, 1.11
Personality Disorders	1.04	0.92, 1.17
Eating and Other Feeding Disorders	0.87 **	0.79, 0.96
Other Mental Health Disorders	1.03	0.98, 1.09
Neurodevelopmental Disorders	1.07 *	1.00, 1.14
Neurocognitive Disorders	0.91	0.68, 1.20
Trans Health	1.37 **	1.27, 1.47
To Be Determined	1.06	1.00, 1.12
Not Available	1.02	0.96, 1.08
Urgent Stream		
Urgent (Reference)		
Non-Urgent	1.12 **	1.07, 1.17
Specific Partnership		
Core (Reference)		
Core and Specific	0.93 **	0.90, 0.95
Clinic		
Dartmouth (Reference)		

	IRR	95% Confidence Interval
Halifax	0.95 **	0.93, 0.98
Sackville	0.92 **	0.89, 0.95
School	0.91 **	0.89, 0.94
Time Period		
Fiscal Year 2019/20 (Reference)		
Fiscal Year 2020/21	0.86 **	0.83, 0.89
Fiscal Year 2021/22	0.91 **	0.88, 0.94
Fiscal Year 2022/23	0.92 **	0.90, 0.95
Constant	18.62	17.34, 20.01

Zero-Inflation of Model	Coefficient	95% Confidence Interval
Treatment Modality		
Mostly Virtual	0.38 **	0.25, 0.52
Age		
Over 18	1.50 **	0.95, 2.06
Presenting Concern		
Trans Health	1.10 **	0.73, 1.46
Specific Partnership		
Core and Specific	-0.82 **	-1.07, -0.57
Clinic		
Sackville	-0.51 **	-0.69, -0.34
Time Period		
Period 4: April 1, 2019, to March 31, 2020	-0.05	-0.20, 0.10
Constant	-1.79 **	-1.89, -1.69

Note: * indicates p-value<0.05 ** indicates p-value<0.01

We also considered the covariates as potential effect measure modifiers. However, after stratification by each of the variables, none of the stratum-specific measurements were considerably different from one another. Although the time period stratum-specific estimates were not significantly different and, therefore, stratifying by time period was not required, we provided these estimates regardless, as they may be of interest in examining the changes in the IRRs over time. Table 16 demonstrates the IRRs for the ratio of days to visits within an episode of care for each time period.

Table 16. Zero-Inflated Negative Binomial Model for Ratio of Days to Visits by Time Period

	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Modality				
Mostly In-Person (Reference)				
Mostly Virtual	0.85 (0.57, 1.27)	1.06 (1.00, 1.13)	1.00 (0.96, 1.05)	1.03 (0.98, 1.08)
Hybrid	1.06 (1.00, 1.12) *	1.14 (1.07, 1.23) **	1.04 (0.99, 1.10)	0.96 (0.92, 1.01)
Age				
0-11 (Reference)				
12-18	0.99 (0.94, 1.03)	0.96 (0.92, 1.01)	0.96 (0.91, 1.01)	0.94 (0.90, 0.99) *
Over 18	0.83 (0.63, 1.09)	0.64 (0.46, 0.89) **	1.47 (1.13, 1.91) **	0.74 (0.53, 1.04)
Presenting Concern				
Substance Use and Related Disorders (Reference)				
Mood Disorders	1.07 (0.97, 1.17)	0.96 (0.86, 1.08)	1.09 (0.95, 1.26)	1.00 (0.89, 1.12)
Anxiety Disorders	1.09 (1.00, 1.19)	0.95 (0.86, 1.06)	1.11 (0.97, 1.27)	1.01 (0.91, 1.13)
Personality Disorders	1.12 (0.86, 1.45)	0.81 (0.58, 1.13)	1.16 (0.86, 1.56)	0.99 (0.81, 1.20)
Eating and Other Feeding Disorders	0.75 (0.62, 0.91) **	0.84 (0.71,1.00) *	1.06 (0.87, 1.29)	0.82 (0.67, 1.01)
Other Mental Health Disorders	1.08 (0.98, 1.19)	0.97 (0.87, 1.08)	1.10 (0.96, 1.26)	0.95 (0.85, 1.07)
Neurodevelopmental Disorders	1.14 (1.02, 1.27) *	0.97 (0.84, 1.11)	1.08 (0.93, 1.26)	1.04 (0.92, 1.17)
Neurocognitive Disorders	0.64 (0.35, 1.19)	0.70 (0.32, 1.54)	1.32 (0.77, 2.26)	0.86 (0.54, 1.38)
Trans Health	1.31 (1.14, 1.49) **	1.37 (1.19, 1.56) **	1.44 (1.20, 1.72) **	1.21 (1.02 1.42) *
To Be Determined	1.25 (0.96, 1.64)	0.91 (0.82, 1.01) **	1.21 (1.06, 1.39) **	0.98 (0.87, 1.09)
Not Available	1.04 (0.95, 1.15)	0.92 (0.82, 1.03) *	1.21 (0.81, 1.81)	0.86 (0.60, 1.25)

	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Urgent Stream				
Urgent (Reference)				
Non-Urgent	1.14 (1.03, 1.25) *	1.12 (1.01, 1.24) *	1.14 (1.05, 1.25) **	1.09 (1.00, 1.18)
Specific Partnership				
Core (Reference)				
Core and Specific	1.01 (0.95, 1.09)	0.87 (0.82, 0.93) **	0.92 (0.86, 0.97) *	0.89 (0.84, 0.94) **
Clinic				
Dartmouth (Reference)				
Halifax	0.92 (0.87, 0.97) **	1.03 (0.98, 1.09)	0.93 (0.88, 0.98) *	0.94 (0.89, 0.99) *
Sackville	0.96 (0.91, 1.01)	0.93 (0.88, 0.99) *	0.89 (0.84, 0.94) **	0.89 (0.84, 0.94) **
School	0.89 (0.84, 0.95) **	0.90 (0.85, 0.96) **	0.92 (0.86, 0.97) *	0.92 (0.87, 0.97) **
Constant	17.37 (15.17, 19.88) **	16.57 (14.14, 19.42) **	15.61 (13.36, 18.23) **	19.62 (17.05, 22.56) **

Zero-Inflation of Model	Coef (95% CI)	Coef (95% CI)	Coef (95% CI)	Coef (95% CI)
Treatment Modality				
Mostly Virtual	1.78 (0.38, 3.17) *	0.67 (0.35, 0.99) **	0.55 (0.29, 0.81) **	0.81 (0.51, 1.10) **
Age				
Over 18	1.70 (0.79, 2.62) **	1.48 (0.26 2.70)	-0.71 (-2.83, 1.41)	2.06 (0.95, 3.17) **
Presenting Concern				
Trans Health	0.78 (0.15, 1.41) *	0.74 (-0.08, 1.56)	1.57 (0.75, 2.38)	1.29 (0.52, 2.05) **
Specific Partnership				
Core and Specific	-0.50 (-0.99, -0.02)	-0.71 (-1.24, -0.18) **	-1.11 (-1.66, -0.55)	-0.82 (-1.28, -0.37) **
Clinic				
Sackville	-0.31 (-0.60, -0.02)	-0.86 (-1.30, -0.41) **	-0.62 (-0.99, -0.24)	-0.54 (-0.92, -0.17) **
Constant	-1.62 (-1.76, -1.48) **	-2.22 (-2.50, -1.94) **	-1.84 (-2.04, -1.64)	-1.96 (-2.13, -1.79) **

Note: * indicates p-value<0.05 ** indicates p-value<0.01

4.4 TIME-TO-EVENT ANALYSIS RESULTS

Figure 6 presents the Kaplan Meier curves for the treatment modalities in-person, virtual, and hybrid. Table 17 reports the median and 90th percentile time-to-event (end of episode) for all treatment modalities. The hybrid modality had the highest median time-to-event (Mdn=223 days) compared to the in-person (Mdn=70 days) and virtual (Mdn=84 days) modalities.

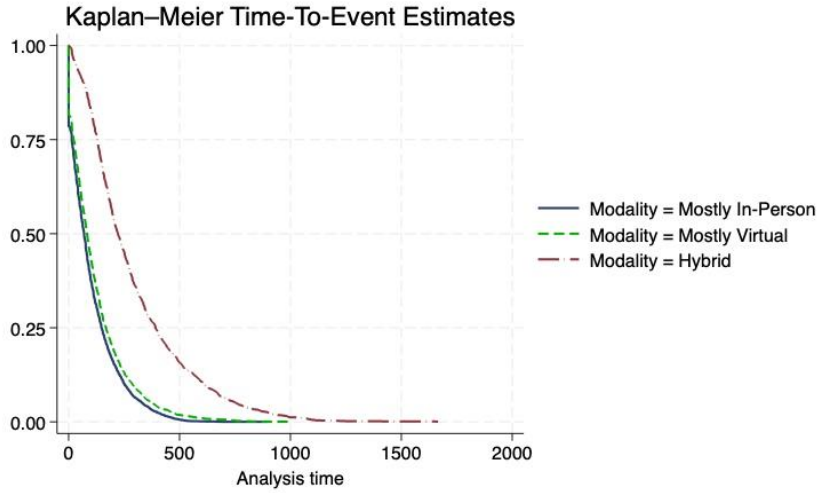

Figure 6. Kaplan-Meier Curve for All Modalities

Table 17. Median and 90th Percentile Time-To-Event for All Modalities

	Median Time-To-Event (Days)	**90th Percentile Time-To-Event (Days)**	**n (Events)**
In-Person	70	252	5049
Virtual	84	288	2495
Hybrid	223	611	1747

Table 18 presents the percentage of episodes completed within 90 days, which represents the length of the typical job planning cycle in CMHA (i.e., assessing clinicians' caseload and capacity for new clients). Approximately 59% (n=2,940) of in-person episodes were completed after 90 days and 53% of virtual episodes were completed after 90 days (n=1,311). Table 19 presents percentages of episodes that were completed within 90 days for each time period.

Table 18. Percentage of Episodes Completed within 90 Days for All Modalities

	% Episodes Completed After 90 Days	n (Events)
In-Person	59%	2940
Virtual	53%	1311
Hybrid	14%	251

Table 19. Percentage of Episodes Completed within 90 Days for All Modalities by Time Period

	% Episodes Completed After 90 Days			
	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
In-Person	50% (n=965)	75% (n=179)	63% (n=348)	48% (n=616)
Virtual	88% (n=7)	49% (n=557)	53% (n=466)	56% (n=231)
Hybrid	7% (n=18)	9% (n=44)	17% (n=89)	18% (n=77)

Table 20 presents the crude Cox Proportional Hazards model. To satisfy the proportional hazards assumptions, we excluded episodes within the hybrid modality from our analysis (see Appendix 1 for further model diagnostics). This model does not account for the lack of independence between episodes. The crude model indicates that at time t, the hazard ratio was 0.86 (CI: 0.82, 0.91; $p<0.01$) times lower in virtual episodes compared to in-person episodes.

Table 20. Crude Cox Proportional Hazards Model for Treatment Duration in Days

	Hazard Ratio (95% CI)	P>|Z|	Std. Error
Modality			
Mostly In-Person (Reference)			
Mostly Virtual	0.86 (0.82, 0.91)	0.00	0.024

The client and system characteristics that were statistically significantly associated with the outcome and resulted in a statistically significant Wald test result and thus included in the model were sex, presenting concern, Specific Partnership, and clinic. Table 21 presents the Cox Proportional Hazards model after adjusting for sex and presenting

concern and stratifying by Specific Partnership and clinic. The adjusted model indicates that at time t, the hazard ratio was 0.89 (CI: 0.84, 0.94; p<0.01) times lower in virtual episodes compared to in-person episodes.

Table 21. Adjusted Cox Proportional Hazards Model for Treatment Duration in Days

	Hazard Ratio (95% CI)	**P>|Z|**	**Std. Error**
Modality			
Mostly In-Person (Reference)			
Mostly Virtual	0.89 (0.84, 0.94)	0.000	0.025
Sex			
M (Reference)			
F	0.94 (0.89, 0.99)	0.021	0.026
Presenting Concern			
Substance Use and Related Disorders (Reference)			
Mood Disorders	0.68 (0.59, 0.79)	0.000	0.051
Anxiety Disorders	0.68 (0.59, 0.78)	0.000	0.048
Personality Disorders	0.85 (0.61, 1.20)	0.359	0.147
Eating and Other Feeding Disorders	0.80 (0.63, 1.01)	0.064	0.098
Other Mental Health Disorders	0.79 (0.69. 0.92)	0.002	0.058
Neurodevelopmental Disorders	0.77 (0.65, 0.90)	0.001	0.063
Neurocognitive Disorders	0.97 (0.50, 1.90)	0.936	0.331
Trans Health	0.88 (0.72, 1.08)	0.224	0.093
To Be Determined	0.76 (0.65, 0.87)	0.000	0.055
Not Available	0.78 (0.66, 0.91)	0.002	0.064

Although the time period was not significantly associated with the outcome, we provided stratum-specific estimates as well, as they may be of interest in examining the changes in the IRRs over time. Table 22 presents the Cox Proportional Hazards model after adjusting for sex and presenting concern and stratifying by Specific Partnership and clinic, for each time period. This model indicates, that at time t, the hazard ratio for the virtual modality in Period 2 was 0.64 (CI: 0.54, 0.76; p<0.01) times lower compared to the in-person modality. However, in Period 4, the hazard ratio for the virtual modality was 1.10 (CI 0.97, 1.25) times greater compared to the in-person modality. This result, however, was not statistically significant.

Table 22. Adjusted Cox Proportional Hazards Model for Treatment Duration in Days by Time Period

	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	Hazard Ratio (95% CI)	Hazard Ratio (95% CI)	Hazard Ratio (95% CI)	Hazard Ratio (95% CI)
Modality				
Mostly In-Person (Reference)				
Mostly Virtual	0.44 (0.13, 1.44)	0.64 (0.54, 0.76) **	0.80 (0.70, 0.90) **	1.10 (0.97, 1.25)
Sex				
M (Reference)				
F	1.00 (0.90, 1.12)	0.96 (0.84, 1.08)	0.89 (0.78, 1.00)	0.88 (0.78, 0.98) *
Presenting Concern				
Substance Use and Related Disorders (Reference)				
Mood Disorders	0.69 (0.54, 0.87) **	0.89 (0.61, 1.29)	0.35 (0.24, 0.53) **	0.73 (0.52, 1.02)
Anxiety Disorders	0.64 (0.50, 0.80) **	0.80 (0.56, 1.13)	0.43 (0.30, 0.63) **	0.67 (0.49, 0.92) *
Personality Disorders	0.86 (0.42, 1.79)	1.62 (0.68, 3.86)	0.35 (0.12, 1.00)	0.83 (0.48, 1.44)
Eating and Other Feeding Disorders	0.86 (0.50, 1.47)	0.65 (0.38, 1.13)	0.54 (0.32, 0.91) *	0.90 (0.53, 1.52)
Other Mental Health Disorders	0.77 (0.60, 0.98) *	0.99 (0.70, 1.41)	0.46 (0.31, 0.68) **	0.86 (0.62, 1.20)
Neurodevelopmental Disorders	0.83 (0.63, 1.10)	0.75 (0.48, 1.17)	0.52 (0.33, 0.79) **	0.76 (0.53, 1.07)
Neurocognitive Disorders	2.66 (0.65, 10.87)	1.01 (0.14, 7.46)	0.47 (0.11, 1.97)	0.68 (0.21, 2.22)
Trans Health	0.77 (0.51, 1.16)	0.92 (0.57, 1.47)	0.51 (0.30, 0.88) *	1.01 (0.61, 1.67)
To Be Determined	0.65 (0.30, 1.41)	1.04 (0.74, 1.46)	0.35 (0.24, 0.52) **	0.76 (0.56, 1.04)
Not Available	0.91 (0.71, 1.17)	0.86 (0.59, 1.25)	2.38 (0.32, 17.99)	1.70 (0.67, 4.30)

Note: * indicates p-value<0.05 ** indicates p-value<0.01

Figures 7-10 presents the Kaplan-Meier curves for the in-person and virtual modalities for each time period.

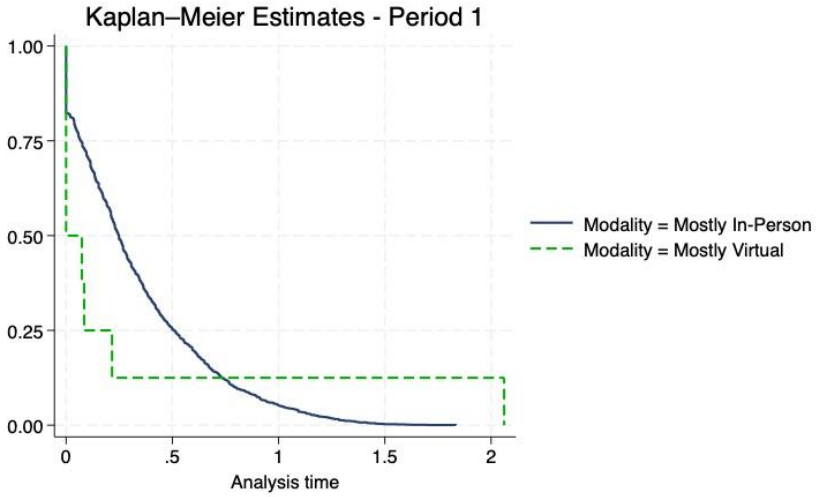

Figure 7. Kaplan-Meier Curve for the In-Person and Virtual Modalities for Period 1 (Fiscal Year 2019/20)

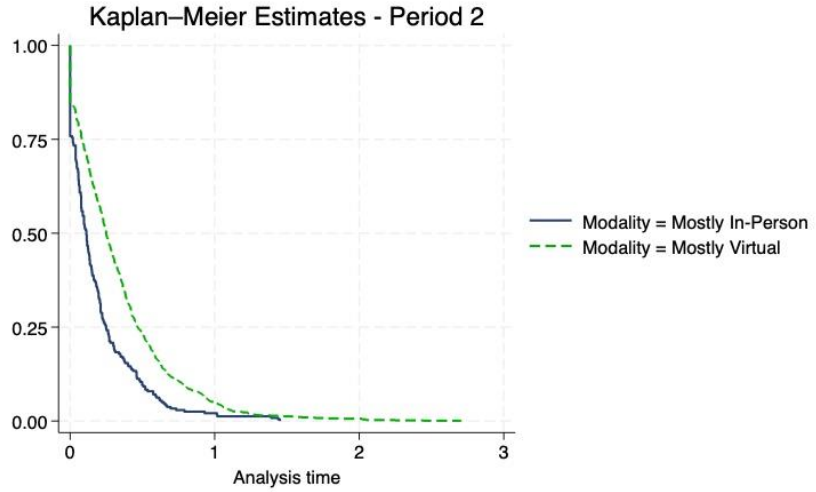

Figure 8. Kaplan-Meier Curve for the In-Person and Virtual Modalities for Period 2 (Fiscal Year 2020/21)

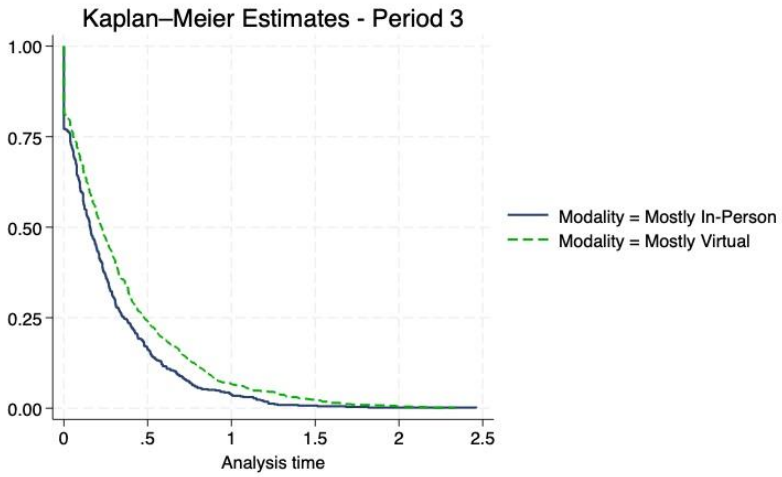

Figure 9. Kaplan-Meier Curve for the In-Person and Virtual Modalities for Period 3 (Fiscal Year 2021/22)

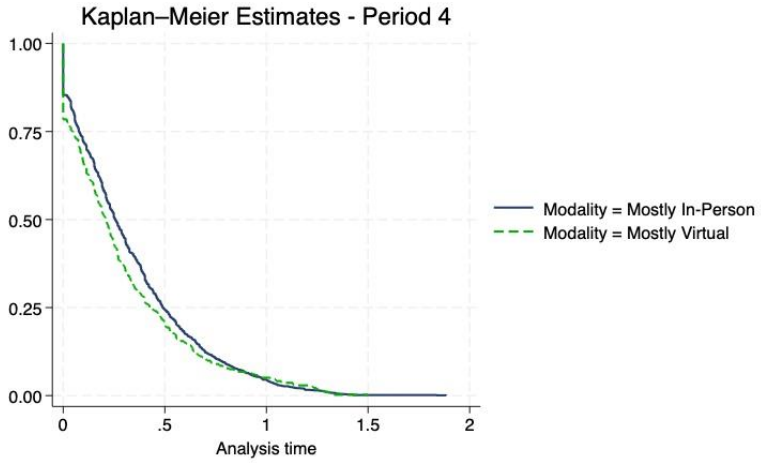

Figure 10. Kaplan-Meier Curve for the In-Person and Virtual Modalities for Period 4 (Fiscal Year 2022/23)

Table 23 presents the results of the crude Shared Frailty model. This model accounts for the lack of independence between episodes clustering based on study ID. The crude model indicates that at time t, the hazard ratio was 0.86 times lower at any given point in virtual episodes than in in-person episodes. This implies that virtual episodes tend to last longer than in-person episodes before concluding.

Table 23. Shared Frailty Model for Treatment Duration in Days

	Hazard Ratio	**SE Coefficient (H)**	**p**
Modality			
Mostly In-Person (Reference)			
Mostly Virtual	0.86	0.029	1.53e-07

The Shared Frailty model has limitations that prevent it from stratifying by multiple strata. Therefore, we cannot compare the adjusted models of the Cox Proportional Hazards model and the Shared Frailty model.

CHAPTER 5: DISCUSSION

5.1 TREATMENT DURATION

To the best of our knowledge, this is the first study to consider lengths of episodes of child and adolescent mental health care with respect to treatment modality. This study aimed to improve our understanding of how treatment modality may be associated with treatment duration for children and adolescents accessing Community Mental Health & Addictions services at IWK Health. The initial observation made by many clinicians was that "virtual care takes longer." Our analysis demonstrated that virtual care was longer in both days and number of visits compared to in-person care in the first two years following the pandemic; however, during the fiscal year 2022/23, episodes delivered mainly by means of virtual care were shorter than those delivered mainly in-person.

Our descriptive analysis showed that over the study period, virtual episodes of care were longer in both days and numbers of visits per episode. We accounted for both numbers of visits, which are relevant both to clients in terms of their interactions with the service and to clinicians and managers for job planning. Considering the length of episodes in days accounts for the intervals between visits, which may vary by client or system factors.

On average, over the full study period, an in-person episode of care had a duration of 6 visits and 101 days. However, in comparison, virtual episodes of care had a duration of 7 visits and 119 days. Despite in-person episodes being shorter than virtual episodes only by a few days and visits per episode, the difference in the average length of one visit, for example, between in-person and virtual episodes, across the 2,495 virtual episodes within the dataset would lead to 2,495 extra visits.

Interestingly, when considering individual fiscal years virtual episodes of care were not consistently longer for all time periods. A pattern we often saw was that in Period 2 (fiscal year 2020/21), at the onset of the pandemic, the difference in the treatment durations between in-person and virtual episodes was the highest, where virtual episodes were much longer than in-person episodes compared to the other time periods. The mean duration of in-person episodes of care during Period 2 was 4 visits, whereas, for virtual

episodes of care, the mean duration was 7 visits. In days, the mean episode length for in-person episodes compared to virtual episodes of care was 69 days and 122 days, respectively. However, in Period 4 (fiscal year 2022/23), virtual episodes of care had a shorter treatment duration in both days and visits compared to in-person episodes of care. The mean duration of in-person episodes of care in visits during this period was 7 visits, whereas, for virtual episodes of care, the mean duration was 6 visits. In days, the mean episode length for in-person episodes compared to virtual episodes of care was 122 days and 107 days, respectively. Another important pattern to note is that when looking at episodes regardless of modality, episodes of care during Period 2 were the longest compared to the other periods both in terms of the mean length of days and visits.

These patterns were also consistent in the multilevel mixed-effects negative binomial model, which accounted for the hierarchical structure of the data for episodes of care nested within individuals. The crude model demonstrated that virtual episodes of care were associated with 19.6% more visits compared to in-person episodes of care. However, after adjusting for age, sex, presenting concern, urgent stream, Specific Partnership, and clinic, and stratifying by time period, this association varied throughout the time periods. In Period 2, the IRR for virtual episodes of care compared to in-person episodes of care was the highest for all time periods, indicating that virtual episodes of care were associated with an increase in the number of visits by 43%. However, in Period 3 (fiscal year 2021/22), the IRR for virtual care episodes compared to in-person care episodes was attenuated (IRR = 1.20; CI: 1.10, 1.30). And, in Period 4, the IRR for virtual episodes of care was the smallest for all time periods except for Period 1 (fiscal year 2019/20) where there were very few virtual episodes of care delivered largely for consultation with clients living outside the typical catchment area. In fact, in Period 4, there were 13% fewer visits in virtual episodes compared to in-person episodes of care.

This pattern was also consistent when conducting a time-to-event analysis of the length of episodes of care in days. Both the crude Cox Proportional Hazards model and the Shared Frailty model produced a hazard ratio of 0.86 for virtual episodes of care compared to in-person episodes of care, indicating that episodes of the virtual modality had a lower probability of experiencing the event, the end of an episode, at a given point

in time, than episodes of the in-person modality. Essentially, virtual episodes of care took longer than in-person episodes, in days, to reach the end of an episode.

After adjusting for sex and presenting concern and stratifying by Specific Partnership and clinic, we found that episodes of the virtual modality had a lower probability (HR=0.89; CI: 0.84, 0.94) of experiencing the end of an episode, at a given point in time than episodes of the in-person modality.

However, it is important to note that the difference in duration between virtual and in-person episodes of care was not static. In our adjusted Cox Proportional Hazards model for each time period, we found that during Period 2, episodes of the virtual modality still had a lower probability (HR=0.64; CI: 0.54, 0.76) of reaching the end of an episode. However, in Period 4, virtual episodes of care had a higher probability (HR=1.10; CI: 0.97, 1.25) of reaching the end of an episode.

Accounting for the lack of independence due to multiple episodes clustered within individual study IDs did not change the parameter estimates. However, it did tighten the confidence intervals, indicating that the variability between clients is important and should be considered. Additionally, we are likely underestimating the variance within individuals, as it is likely that not all episodes of care belonging to an individual were captured within the study period, with some occurring outside the study window. For future data collection and analyses, capturing more comprehensive information on individual client characteristics may help explain the observed differences in episodes of care. This may provide a better understanding of the variability within individuals.

5.2 TIME PERIOD

There could be a multitude of reasons why virtual episodes of care were longer than in-person episodes of care during Period 2 but shorter during Period 4. Period 2, between April 1, 2020, and March 31, 2021, began the COVID-19 pandemic related restrictions. Operating mental health services through a virtual medium was relatively new during this time (3,41,42). Therefore, this required adjustments and adapting to this new service delivery method for both clinicians and clients. Clinicians had to learn how to use virtual

care and work through this new virtual medium; it took time to develop these skills (42). Also, clinicians had to review safety considerations pertaining to using virtual care with the client, which took up time within an appointment, and thus, it took longer to get to the work of identifying treatment goals and providing treatment (42). Moreover, clients had to adjust to this new way of receiving care (84). Further, during Period 2, the proportion of clients referred to urgent care increased, as did the average HEADS-ED score, which may reflect greater treatment needs and complexities during this time, which may not be fully captured by the variables in our dataset, potentially contributing to longer episodes of care (85). All of this could contribute to virtual episodes of care having more visits and more prolonged treatment in days to adjust to this new way of care.

During Period 2, or the onset of the pandemic, the number of in-person episodes of care was limited, as only those with safety concerns had in-person care; thus, those receiving in-person care during this time may have been different from those receiving virtual care (42,47). Also, clinicians may have preferred using the virtual modality due to concerns regarding the risk of contracting COVID-19 (7).

In Period 4, our most recent period, from April 1, 2022, to March 31, 2023, post-COVID-19 pandemic restrictions, there was seemingly more choice between the two modalities, and there were a lot fewer episodes of care conducted virtually (n=413) compared to the start of the COVID-19 pandemic in Period 2 (n=1,130). Perhaps those choosing virtual care may be systematically different from those choosing in-person care, where presenting concerns and treatment needs may be less acute and less complex than those choosing in-person care, and thus, virtual episodes of care during this time may be shorter (47). Furthermore, due to virtual care having been established for at least two years by this time, efficiency and proficiency in using technology improved for both clients and clinicians over time (42).

5.3 TIME-TO-EVENT

The median time-to-event and the 90th percentile time-to-event provide valuable information to understand the proportion of episodes completed within a specific time frame and can be useful when considering job planning, which is conducted quarterly in

CMHA. Clients for whom treatment is not completed within a quarter need to be carried forward to the next quarter, thereby adding to a given clinician's caseload and reducing the clinician's capacity for new clients. We found that the median time-to-event for in-person episodes of care (Mdn=70 days) was shorter than virtual episodes of care (Mdn=84 days), meaning that 50% of in-person episodes were completed after 70 days, whereas 50% of virtual episodes were completed after 84 days. We also found that 90% of in-person episodes were completed after 252 days, whereas 90% of virtual episodes were completed after 288 days.

We also looked at the proportion of episodes completed within a quarter (90 days). We found that 59% (n=2,940) of in-person episodes were completed after 90 days, and 53% of virtual episodes were completed after 90 days (n=1,311). Additionally, we looked at the proportion of episodes completed within a quarter for each time period. We found that during Period 2, 75% of in-person episodes and 49% of virtual episodes were completed after 90 days. However, in Period 4, this changed, and we found that 48% of in-person episodes and 56% of virtual episodes were completed after 90 days.

5.4 RATIO OF DAYS TO VISITS

We considered the ratio of days to visits to provide a notionally common measure for which to aid in comparisons across time periods and in adjustment for client and system characteristics. This also allowed us to observe variations in intersession wait times and frequencies of visits within an episode of care. If the wait times were longer during a given period, we would expect the ratio of days to visits to be higher for that period. We note this accounts for intersession wait times, which do have an impact on treatment progress and, therefore, likely affect the number of treatment sessions, but does not account for the typically longest wait times, which are from referral to the first (Choice) visit or from Choice to the first treatment (Partnership) visit. Our analysis showed that when we compared the ratio of days to visits within an episode for the in-person and virtual modalities, even over each time period, there was no significant difference in the number of days between each visit, which means that the time between visits would not be driving the difference in treatment duration that we were seeing between in-person and

virtual care (see Table 15). However, our zero-inflated negative binomial model did reveal that virtual episodes of care were more likely to consist of one visit during one day during Periods 2, 3, and 4, compared to in-person episodes of care. This could be due to those only requiring one visit to meet their needs, and thus treatment was completed within one visit, or perhaps due to those who were not able or chose not to return for care; unfortunately, we do not have information on their reason for the end of an episode.

5.5 SENSITIVITY ANALYSIS (180-DAY RULE)

We were interested in how a different definition of episodes of care would impact the treatment duration. Our literature review provided examples of both the 90-day and 180-day decision rules for episodes of care in mental health research (57–61,63,86). Our sensitivity analysis, in which we defined episodes as periods of service use with fewer than 180 days between care contacts, demonstrated that episode lengths did not vary significantly descriptively. Episodes and their characteristics for the 90-day and 180-day rules were similar (see Appendix 3). Further, the IWK's policy requires clinicians to conduct a new Choice appointment after a client's 90-day absence from treatment. As such, we adopted the 90-day rule for our analyses. Interestingly, contrary to the policy, when examining the Choice data, many (40%) episodes did not begin with a Choice appointment; however, completing a chart review may help provide further information for validating an episode of care using either the 90-day or 180-day rule.

5.6 SENSITIVITY ANALYSIS (HEADS-ED SCORE)

The HEADS-ED score captures the acuity of the mental health need when a client presents to services. The HEADS-ED score is a triaging tool used at Central Referral to support triage and disposition at intake to CMHA (74). We were curious whether accounting for the HEADS-ED score at intake would impact any associations between treatment modality and treatment duration among clients entering CMHA services following triage at Central Referral (rather than via the inpatient unit or emergency department).

It should be noted that the number of episodes with a HEADS-ED score is limited (3,917 out of 9,291 episodes), as only clients who enter through the Central Referral pathway will receive a HEADS-ED score. It is important to note that the HEADS-ED score is not considered missing for the subset of clients without scores; instead, only a subset of the population of the dataset will receive this score as it is used only at triage at entry via Central Referral. It is not used in other clinical pathways or settings, such as emergency services or inpatient units, as clients are referred directly to CMHA services following assessments in those services and do not require further triage. Therefore, it would not be appropriate to impute scores based on the limited variables within our dataset, as the HEADS-ED scores are not missing at random (87). However, we conducted a sensitivity analysis comparing episodes with and without HEADS-ED scores which demonstrated no significant differences in the results.

Our sensitivity analysis revealed that, when restricting to this subset of episodes of care with a HEADS-ED score and also adjusting for the HEADS-ED score, this did not result in a significant change in the estimates for all modeling (see Appendix 4). This may suggest that service use patterns for those entering services through different pathways do not differ significantly. Also, acuity at intake may not have a significant impact on the association between treatment modality and treatment duration.

5.7 FACTORS ASSOCIATED WITH EPISODE LENGTH

We aimed to identify variables in our dataset that could explain long episodes of care. When categorizing episodes into one of four clinically relevant categories: short (1 visit), medium (below average) (2-8 visits), medium (above average) (9-18 visits), and long (19 or more visits), we found that the distribution of many variables was consistent across all categories. The extended length of certain episodes may be due to variables not captured within our dataset. For example, clinical presentation or sociodemographic variables affecting treatment needs or ability to attend services are likely important in affecting the length of treatment required to achieve goals, but it is not captured sufficiently in the administrative data.

However, the variable that did stand out was Specific Partnership, as the long episodes had the highest proportion (45%) of Core and Specific Partnership visits. Episodes consisting of both Core and Specific Partnership visits are likely to be longer as this variable typically indicates that the episode consisted of multiple care providers, where additional Specific Partnership work occurred alongside the Core work (75). This means there are likely more visits within an episode of care in order to achieve goals of treatment, which would lead to a longer duration in visits.

The most common treatment modality in the long category was hybrid care. Despite being the smallest category, the hybrid treatment modality consistently had the longest episodes. Despite our efforts to understand this category by grouping it into subcategories according to the percentage of virtual or in-person visits, there was no clear pattern regarding what contributed to the extended episode lengths. Exploring the client and system characteristics associated with the hybrid episodes of care did not provide any clear insights into why these hybrid episodes were so long. It was suspected that the client was driving the length of the episode rather than the modality, and there were likely other factors contributing to the episode's length that were not captured within our dataset. For example, if the client was experiencing more severe mental health concerns or had complex needs that would not be captured in the client characteristics within our dataset, they may have more frequent check-ins or require longer follow up. Also, if an individual was receiving care over numerous years, especially prior to and during the COVID-19 pandemic, they were just more likely to experience both in-person and virtual care and thus be placed within the hybrid category.

5.8 SUMMARY

When considering episodes of care in terms of length in days and in the number of visits, the observation that virtual care takes longer appeared to be true in the first year following the onset of the pandemic. This may have been influenced by inexperience using virtual care or greater distress leading to greater treatment needs.

However, by fiscal year 2022/23, episodes of care conducted largely virtually were shorter than those conducted largely in-person. This may be the result of self-selection of

clients to virtual care with different treatment needs or barriers to in-person care, differences in engagement with clinicians, and a general improvement in experience using virtual care.

Future studies would benefit from more comprehensive information on individual client characteristics, such as sociodemographic information and measures of complexity, to help explain the observed differences among episodes of care. Additionally, information on predictors of outcomes may help explain variations in patterns of service use (63).

CHAPTER 6: CONCLUSION

The objective of this master's thesis was to operationalise a means of measuring episodes of care using administrative data to improve our understanding of how treatment modality impacts treatment duration for children and adolescents accessing Community Mental Health & Addictions services at IWK Health. We aimed to:

1. Describe episodes of care (numbers of visits within an episode of care, episode length) by treatment modality (virtual vs. in-person vs. hybrid) among children and youth receiving outpatient IWK MHA services between June 30, 2018, and November 2, 2023.
2. Determine whether client characteristics (e.g., age, sex, presenting concern, total HEADS-ED score at intake) influence any associations between treatment modality and episodes of care for fiscal years 2019 to 2022.
3. Determine whether system factors (e.g., CMHA clinic, urgent vs. non-urgent stream, Specific Partnership visits, time period) further contribute to any associations between treatment modality and episodes of care for fiscal years 2019 to 2022.

These objectives were achieved by means of an analysis of routinely captured administrative health data, employing descriptive statistics, a multilevel mixed-effects negative binomial model, a zero-inflated negative binomial model, and a time-to-event analysis. Ultimately, measuring episodes of care in either days or visits led to the same conclusions. However, when we began this analysis, it was important to consider multiple measures of episodes of care to ensure we adequately answered the question, "does virtual care take longer?". Additionally, these different outcomes have different purposes: treatment length in visits may be valuable to clinicians and clients for understanding the typical treatment length, while treatment length in days is useful for assessing the completion of episodes within specific time frames, such as within a quarter, or when considering the impact of wait times on episode duration.

Over the observation period, virtual episodes of care were on average longer and had more visits per episode than in-person care. However, the time period modified this

association between treatment modality and treatment duration. We found that during Period 2 (fiscal year 2020/21), during the start of the COVID-19 pandemic, when mental health services rapidly shifted from primarily in-person to primarily virtual care, virtual care was much longer than in-person care. The average number of days and visits within an episode was longer for the virtual modality than for the in-person modality. However, this shifted during Period 4 (fiscal year 2022/23) when virtual care was more established, and services had shifted back to being primarily in-person; virtual episodes had a lower average number of visits and days compared to in-person episodes.

6.1 STRENGTHS

To our knowledge, this is the first study to address the association between treatment modality and treatment duration. Concerns were identified that virtual care takes longer, and this study used a definition of episodes of care to provide insights into how virtual care impacted treatment duration, both in days and in visits.

A significant strength of this study is the creation of episodes of care. The IWK's policy is to require a new Choice appointment after a 90-day absence from services. Although we used this policy to guide our approach to defining an episode of care, the transformation of the administrative data and the development of episodes of care are significant contributions, as episodes of care had not previously been utilized to describe health service use despite the existence of the policy. Additionally, our initial analysis revealed that nearly 40% of the episodes of care did not begin with a Choice appointment, indicating that this policy is not consistently followed. As such, we could not operationalize a new episode of care as beginning with a Choice appointment. We conducted a sensitivity analysis of a 180-day absence from services, as has been reported elsewhere, with no difference to the study outcomes.

Given the data's complexity, understanding service use patterns and facilitating comparisons between cohorts would not have been possible. The IWK CMHA service follows a CAPA model in which clients are expected to receive care appropriate to their needs and goals, translating to episodic need. As such, this requires translating the administrative data into episodes of care in order to study and meaningfully interpret

questions such as “Does virtual care take longer than in-person care?” Existing quality improvement activities mainly use indicators derived from individual datasets; however, creating the episodes of care, which required combining individual datasets and transforming the data, allows for a more holistic view of the service use. Defining and creating these episodes allows for a better understanding of when services begin and conclude for a given episode of need for care, thus allowing us to make meaningful comparisons between treatment modalities and draw conclusions based on service use patterns.

Measuring service use using episodes of care, rather than looking at the average number of visits, can help to understand what treatment looks like and unpack the “average” treatment duration. Episodes of care help to understand service use patterns that averages may mask, patterns reflecting different types of clients and different needs, including crisis response to complex care with long trajectories.

Using episodes of care to measure health service use may help to better understand whether the services are meeting the needs of those in receipt of them. Future work may involve understanding what type of services work for whom, such as those with very short or very long episodes, which may require a different type of service than what is offered in CMHA. Moreover, the creation of these episodes not only allowed us the ability to assess how treatment modality impacted treatment duration but also opens up other opportunities for exploring more patterns of service use.

Another strength is that this dataset is large and spans numerous years, capturing all clients being seen in CMHA clinics. Thus, it allowed us to assess many episodes of care in each modality over numerous years, allowing us to understand how time periods affected the association between treatment modality and treatment duration.

6.2 LIMITATIONS

The use of administrative data within this study presents restrictions regarding the information that is available. Certain client, clinician, and system characteristics could be

beneficial to include within this study as they could provide additional information regarding episodes of care; however, they were not captured.

A trade-off of using administrative data is that although it is generally useful and pragmatic, allowing for a relatively complete capture of service use and reducing the need for additional data collection, it is often limited in terms of clinical and sociodemographic variables that may affect both the need for services and service use.

Client characteristics, such as clinical presentation, likely influence service use patterns. We have the overarching category of the presenting concerns; however, we do not have information regarding the nuances and specifics of the presenting concerns that may be driving the episode's length. For example, individuals with comorbidities may require more complex care, requiring a longer episode duration. However, comorbidities were not included within this dataset; therefore, we could not account for this variable. Further, the complexity of the client's case or the reason for presentation may also impact treatment duration. Other factors, such as the social determinants of health, which would impact engagement in care and barriers to care, would be useful to help predict treatment trajectories.

Another variable not considered in this study is the location of the virtual care sessions. It is important to acknowledge whether clients have access to a private space for their sessions and whether these occur in their homes or at school. These factors could potentially impact care episodes and the client's comfort level in sharing their thoughts and working towards treatment goals (42,46,49,51). It is important to consider the trade-offs between virtual and in-person care. In virtual care, clients can attend sessions from the comfort of their homes/schools. However, the availability of a private area for confidential discussions may vary.

The number of clinicians involved in an episode of care could also impact treatment duration, specifically in visits, as the client may have multiple encounters with multiple providers within an episode, driving up the treatment duration. Unfortunately, we did not have information on the clinician involved in the visit; therefore, we could not account

for the number of clinicians involved in each episode. However, we did have a proxy for this, Core and Specific Partnership, as those receiving Specific work alongside Core work were most likely seeing another clinician and would have more sessions.

Similarly, we did not have information on whether the clinician was designated to provide only virtual care. Certain clinics have designated providers to solely provide virtual care, and thus, service use patterns for their client population may differ from those receiving care from other providers who provide just in-person or both virtual and in-person treatment. This was not implemented until recently, so it would not have impacted our study results; however, it would be beneficial to have this information for future work.

We did not have information about the type and quality of care, so we had to assume that all visits were of equal quality. However, different types of care, varying quality, engagement in care, or even differing client-clinician relationships could impact the relationship between treatment modality and duration and lead to variations in treatment length.

Finally, we do not have a way to confirm that the end of a given episode of care is truly the end of care and that the treatment goals were met. It is quite possible that the client may stop coming in for care despite treatment not being considered completed. This would be difficult to capture as administrative data is captured in real-time. For clients who are expected to return to services but are lost to follow-up, it would be necessary to retroactively code them accordingly. However, the data capture is often incomplete, making it difficult to determine whether clients are lost to follow-up or if the data is missing. Additionally, the episode of care we measured was situated within other health care service use, and we did not have information on additional visits to other services, such as to their family physician or to the emergency department. Therefore, it is difficult to draw conclusions regarding how long it takes to reach treatment goals, depending on modality.

6.3 IMPLICATIONS

With the advancement of virtual care as a treatment modality following the onset of the COVID-19 pandemic and the evolving client treatment needs, evidenced by changes in patterns of mental health service use and acuity, this area of research has become increasingly important, especially with the risk of virtual care being abandoned as we transition back to pre-pandemic (or pre public health restrictions) operations and processes, thus reducing equitable access to mental health services.

This information can be valuable to clinicians, clients, and their families regarding expected treatment timelines for presenting concerns, acuity, and treatment modality and aid in informing decisions made between clinicians and clients regarding what care will look like moving forward. While we are not drawing causal conclusions, episodes have varied by modality in different time periods, and we can use those insights for job planning and communicating with clients and families when discussing treatment options and potential trade-offs. Job planning is data-driven and is conducted quarterly based on current demand. Therefore, information about how treatment duration may vary depending on treatment modality could and should be utilized to guide job planning. For example, an average of one additional visit per episode (average number of visits per in-person episode during 2019/21 vs. average number of visits per virtual episode during 2020/21) for 1,130 episodes during that fiscal year would mean an extra 1,130 visits that would have needed to be accommodated.

Researching how service use differs for treatment modality adds to our understanding of children and adolescents' mental health needs and aids in needs-based planning, supporting the service delivery model, including modality (in-person/virtual) is matched to the need and preferences of the children, youth, and families who come for care. This research considers service use for child and adolescents and thus can be useful to clients and their families, particularly around treatment options and expected pathways. Furthermore, this research can aid in understanding the effectiveness of these services by observing service use patterns through the number of visits, which is essential for needs-based planning and can be useful in further research studying outcomes. Moreover, this

research demonstrates that the duration of treatment for virtual care is comparable to in-person care, challenging the perception that virtual care takes longer. Consequently, it supports the continuation of virtual mental health services for children and adolescents, ensuring that those who benefit from virtual care can maintain access.

This research serves to enrich the IWK MHA Program's current health service-oriented evaluation of CMHA services, which relies on key performance indicators (e.g., average numbers of referrals/visits to CMHA services per month, average wait times) to a client- and family-oriented approach that captures individual treatment trajectories (e.g., length of treatment expected) by client, treatment modality, and service characteristics.

The creation of episodes of care opens up many opportunities to assess service use patterns among children and adolescents accessing CMHA services at IWK Health.

6.4 FUTURE DIRECTIONS

A few areas should be explored in future studies to further enhance our understanding of virtual mental health care delivery.

Firstly, a future area of research could involve conducting a chart review to assess the validity of the definition of an episode of care with the clinician's or client's perception of the beginning and end of treatment. Currently, we do not have a way to confirm that the end of the episode in the dataset represents the achievement of treatment goals. Thus, a chart review could provide valuable information regarding service use patterns and validate the definition of an episode of care. Further, a chart review could aid in understanding how virtual care is being used presently, whether it is comparable to in-person care or used more as a brief check-in.

An additional research area is to explore how incorporating missed and no-show appointments into the definition of an episode of care would impact the number and duration of an episode of care. It may be helpful to understand whether individuals with high rates of missed or cancelled appointments have longer or shorter episodes of care

than clients with more regular attendance to scheduled appointments, and whether this varied by other client or system characteristics, such as wait times (88).

Another important area of future research should involve assessing the effectiveness of virtual care. While our study provided information regarding how treatment modality impacts the duration of episodes, the efficacy of virtual care remains an important aspect to be explored. Measures of efficacy in the form of routine outcome measures, alongside information regarding expected treatment timelines, would be important in program-level decisions surrounding the continuation of virtual care and, at the clinical level, supporting shared decision-making. To achieve this, mental health outcomes would need to be captured. There would need to be a way to capture how treatment of all modalities impacts children and adolescents' mental health. Client-reported outcome measures, such as the Revised Children's Anxiety and Depression Scales or the Goal-Based Outcome Tool, are important; however, they are not often routinely captured in health care (89,90). Further, having information regarding an individual's clinical, developmental, and cultural needs can help ensure that the services are appropriately matched to their needs.

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Appendix 1: Model Diagnostics

MULTILEVEL MIXED-EFFECTS NEGATIVE BINOMIAL MODEL

To begin building the model, we added the client and system characteristics one at a time, assessing how the addition of the variable impacted both the estimates and the AIC. Age, sex, presenting concern, urgent stream, Specific Partnership, clinic, and time period, when treated as confounders, did not change the IRR very much, indicating that these variables were not considered confounders (see Appendix 2). However, as each variable was added, the AIC was lowered by at least two points, indicating that the variable improved model fit; therefore, it was important to include these variables in our model.

We considered the client and system characteristics as potential effect measure modifiers. Age, sex, presenting concern, urgent stream, Specific Partnership, and clinic did not result in the stratum specific measurements being considerably different from one another and, therefore, were not considered as an effect measure modifier. However, when treated as an effect measure modifier with modality, time period resulted in significant differences between the stratum specific IRRs and, therefore, it was considered an effect measure modifier.

We then restricted the model to only episodes longer than one visit so that we could fairly compare modalities, as by the nature of the definitions, the hybrid category requires two visits, whereas virtual and in-person episodes may consist of only one visit—doing so lowered the AIC by at least two points indicating it improved model fit. About 17% of episodes had a duration of one visit. We also considered excluding outliers; therefore, we restricted the model to episodes shorter than 25 visits, the 95th percentile. This lowered the AIC by at least two points indicating it improved model fit as well. We also considered excluding episodes longer than three standard deviations above the mean, thus more than 35 visits; however, the AIC was higher when doing so, indicating this resulted in a poorer fit.

The assumption that the model had no influential outliers was met. Upon initial investigation of the influential outliers, there was one episode with a Cook's Distance of

3.07e+12. A characteristic of this episode that may have caused the model not to fit well was that the age associated with the episode was over 18. When this episode was excluded from the model, the estimates did not change. If this episode was excluded, the other Cook's Distance data points were close to zero, with a few points further away, with a Cook's Distance between 0.06 and 0.1, as shown in Figure 11. There were no other points that were very far away from zero that would indicate that there were influential outliers. We also checked for influential outliers using the DFBETA statistics. We found that very few observations had a DFBETA greater than 0.2 or less than -0.2. Upon investigating the characteristics (age, sex, presenting concern, urgent stream, Specific Partnership, clinic, time period) associated with these observations, we did not observe clear patterns indicating why the model may not fit them. When we removed episodes that contained these potential influential outliers, there was no change in the estimates. Therefore, there was not enough evidence to suggest that there were influential outliers.

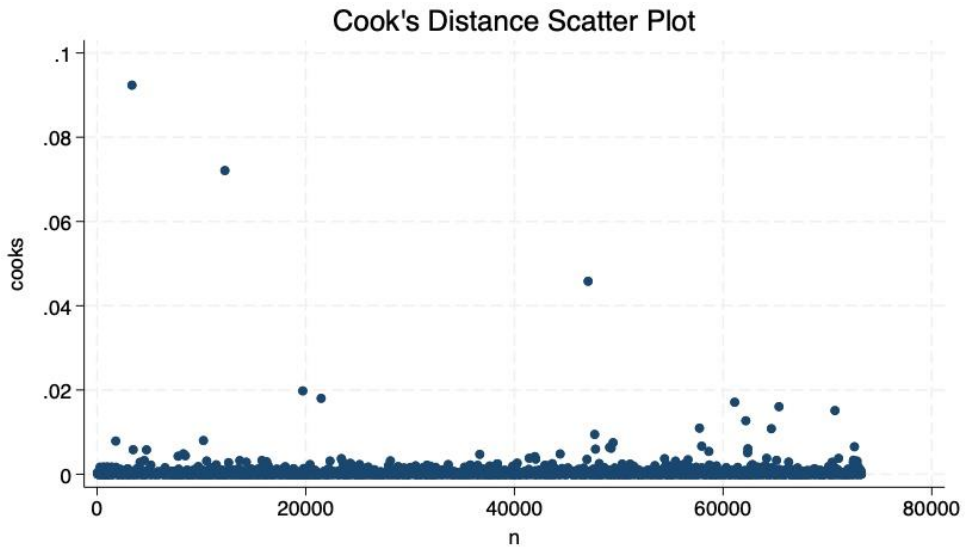

Figure 11. Scatterplot of Cook's Distance, Multilevel Mixed-Effects Negative Binomial Model

Our final model included various fixed effects such as age, sex, presenting concern, urgent stream, Specific Partnership, and clinic. We treated time period (fiscal years 2019/20, 2020/21, 2021/22, and 2022/23) as an effect measure modifier and provided

stratified measurements accordingly. We also restricted to episodes with more than one visit but less than 25 visits. Additionally, we treated the study ID as a random effect. Our model does not include random slopes. In developing the multilevel mixed-effects negative binomial model, significant convergence issues were encountered when attempting to include random slopes, most likely due to the large number of clusters and few episodes per cluster. We compared the regular negative binomial model to the multilevel mixed-effects negative binomial model. The estimates did not change significantly; however, the AIC was lower by more than two points using the multilevel mixed-effects negative binomial model.

ZERO-INFLATED NEGATIVE BINOMIAL MODEL

To build the model, we first used a step-wise approach to identify the variables that could affect the over-inflated zeros. We found that modality (Mostly Virtual), age (Over 18), presenting concern (Trans Health), Specific Partnership (Core and Specific), clinic (Sackville), and time period (Period 4) were significant.

Next, we started building the zero-inflated negative binomial model. We added each client and system characteristic individually, assessing how the model estimates and AIC changed. We included a variable in the model if it changed the estimates by more than 10% (indicating it was a confounder) or if it improved the model fit by decreasing the AIC by more than two points. The final model includes age, presenting concern, urgent stream, Specific Partnership, clinic, and time period. All these variables lowered the AIC, yet none changed the estimates by more than 10% (see Appendix 2).

We also considered the covariates as potential effect measure modifiers. However, none of the variables resulted in the stratum-specific measurements being considerably different from one another. Therefore, we concluded that none of the variables were effect-measure modifiers. Although the stratum-specific estimates, when stratifying by time period, were not significantly different and, therefore, stratifying by time period was

not required, we provided these estimates regardless, as they may be of interest in examining the changes in the IRRs over time.

We assessed for influential outliers using Cook's Distance and DFBETA statistics. As shown in Figure 12, a scatter plot of Cook's Distance data points, most points were close to zero, with a few points further away, with a Cook's Distance between 0.015 and 0.02; however, there were no points that were very far away from zero that would indicate that there were influential outliers.

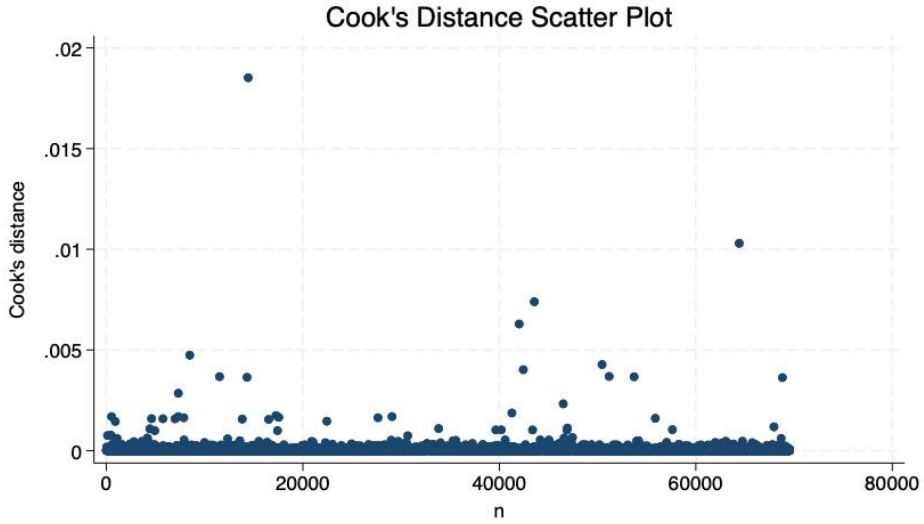

Figure 12. Scatterplot of Cook's Distance, Zero-Inflated Negative Binomial Model

We found that very few observations had a DFBETA greater than 0.05 or less than -0.05. Upon investigating the characteristics (age, presenting concern, urgent stream, Specific Partnership, clinic, time period) associated with these observations, we did not observe clear patterns indicating why the model may not fit them. When we removed episodes that contained these potential influential outliers, there was no change in the estimates. Therefore, there was not enough evidence to suggest that there were influential outliers.

We compared the regular negative binomial model to the zero-inflated negative binomial model. The estimates did not change significantly; however, the AIC was lower by more than two points using the zero-inflated negative binomial model.

We considered the zero-inflated negative binomial model, which handles the excess zeros but does not account for the lack of independence, and the multilevel mixed-effects negative binomial model, which does account for the lack of independence. Both models had their trade-offs. However, when comparing the models, the AIC was lower in the zero-inflated negative binomial model.

TIME-TO-EVENT ANALYSIS

The client and system characteristics that were statistically significantly associated with the outcome and resulted in a statistically significant Wald test result and thus included in the model were sex, presenting concern, Specific Partnership, and clinic. Although the time period was not significantly associated with the outcome, we provided stratum-specific estimates as well, as they may be of interest in examining the changes in the IRRs over time.

A key assumption of the Cox Proportional Hazards model is that the ratio of the hazards comparing exposure groups remains constant over time. To ensure this assumption was met, we checked the interaction between each exposure variable and time, determining if the hazard ratio changes with time. We used the Kaplan-Meier curve to estimate and visualize the time-to-event functions, observing whether they had similar patterns. We also used the Schoenfeld Test to determine whether the assumption of proportional hazards was met. The Kaplan-Meier curve, shown in Figure 13, demonstrates that the in-person and virtual time-to-event functions were similar; however, the hybrid time-to-event function was quite different. Figure 14 shows the Schoenfeld Test, which demonstrates how the curves were almost parallel; however, the Global Schoenfeld Test was significant, indicating that the proportional hazards assumption was violated.

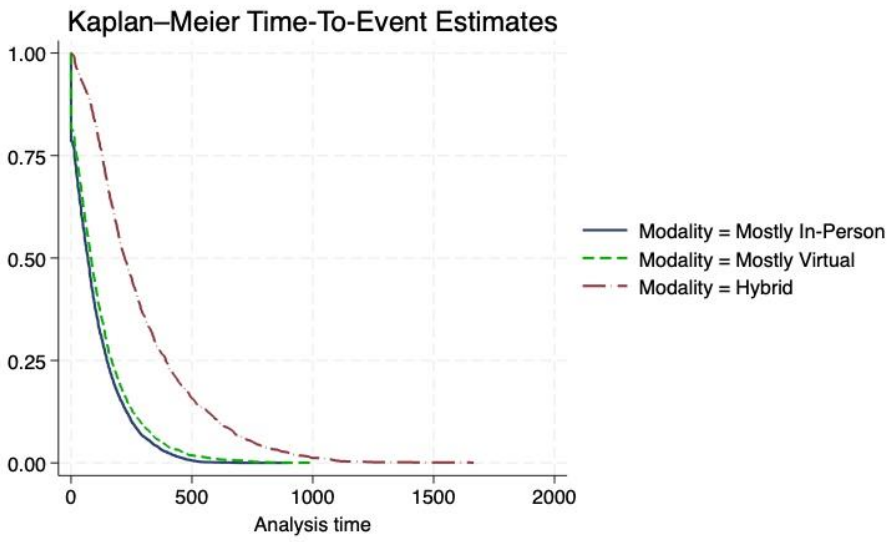

Figure 13. Kaplan-Meier Curve for All Modalities

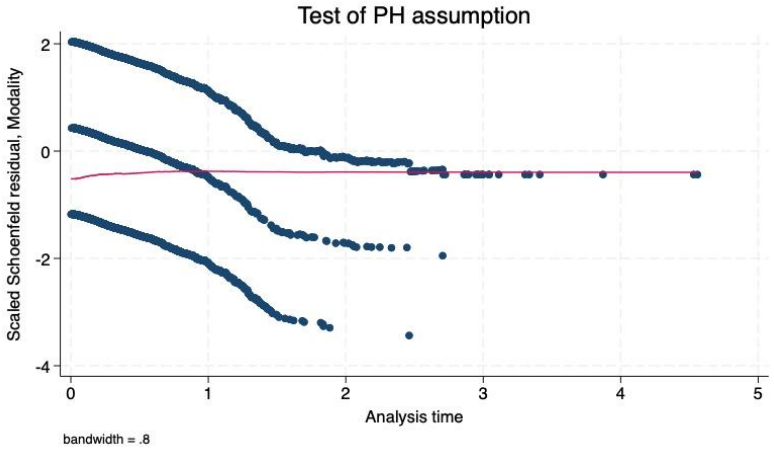

Figure 14. Schoenfeld Test for All Modalities

To satisfy the proportional hazards assumptions, we excluded episodes within the hybrid modality from our analysis because the patterns of service use were different from the other modalities, and likely, the extended duration of episodes in this category was due to the nature of the client rather than the modality. Figure 15 demonstrates the Cox Proportional Hazards Regression for the Mostly In-Person and Mostly Virtual modalities, where it appears as though the lines were parallel. The Global Schoenfeld Test was still significant, indicating the proportional hazard assumption was violated; however, because the sample size was quite large, the global test would be significant despite the

hazards being proportional. Figure 16 shows the Schoenfeld Test for only the in-person and virtual modalities, where it appears as though the curves were parallel, indicating the proportional hazards assumption was met. Furthermore, the Log-Log plot in Figure 17 also helps to confirm that this assumption was met, as the lines appear parallel.

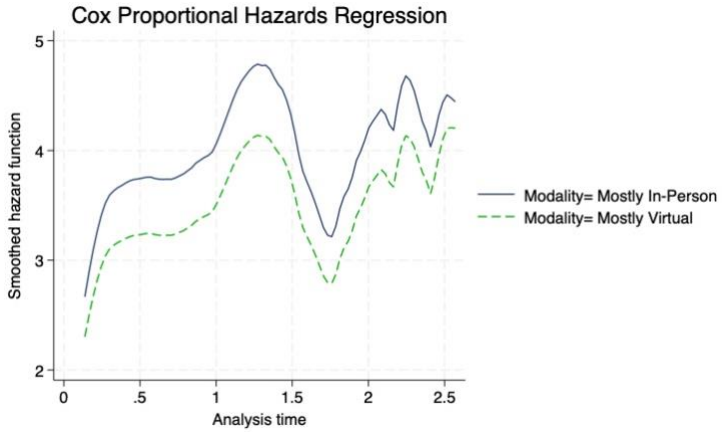

Figure 15. Proportional Hazards Curve for In-Person and Virtual Modalities

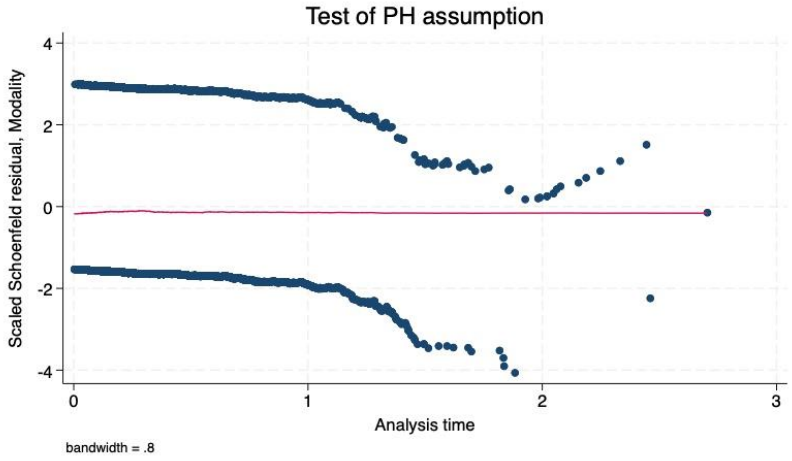

Figure 16. Schoenfeld Test for In-Person and Virtual Modalities

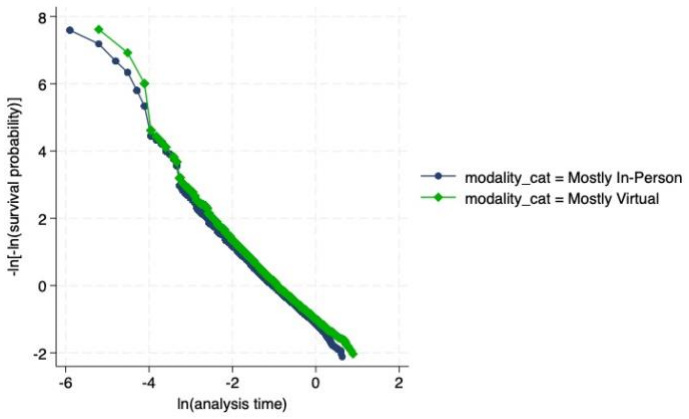

Figure 17. Log-Log Plot for In-Person and Virtual Modalities

We tested the proportional hazards assumptions for the variables sex, presenting concern, Specific Partnership, and clinic. The Specific Partnership and clinic variables were not proportional; therefore, we stratified our analysis by Specific Partnership and clinic.

Other assumptions include random censoring, no influential observations, the model was not over-specified, and the outcomes are independent. Within this analysis, an episode of care was an event. Therefore, each individual experienced the event. Thus, the assumption of random censoring was assumed to be met.

Figure 18 shows a plot of the deviance residuals, where no extreme values were observed, and the residuals were fairly close to zero. Therefore, it can be interpreted that the assumption that there were no influential observations was met.

The assumption that the model was not over-specified was met as sufficient observations exist for the number of variables. The number of episodes and events was 7,544 and with five predictor variables, which yields a ratio of about 1,500 events per predictor variable, this exceeds the recommended minimum of 10 events per predictor variable.

The Nelson-Aalen cumulative hazard was compared against the Cox-Snell Residual to test model fit, shown in Figure 19. The two lines were very similar, indicating the model has good fit.

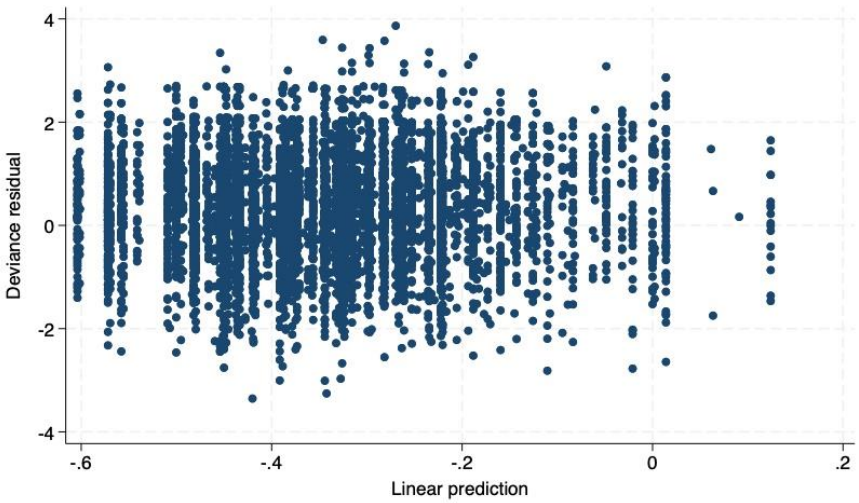

Figure 18. Deviance Residuals

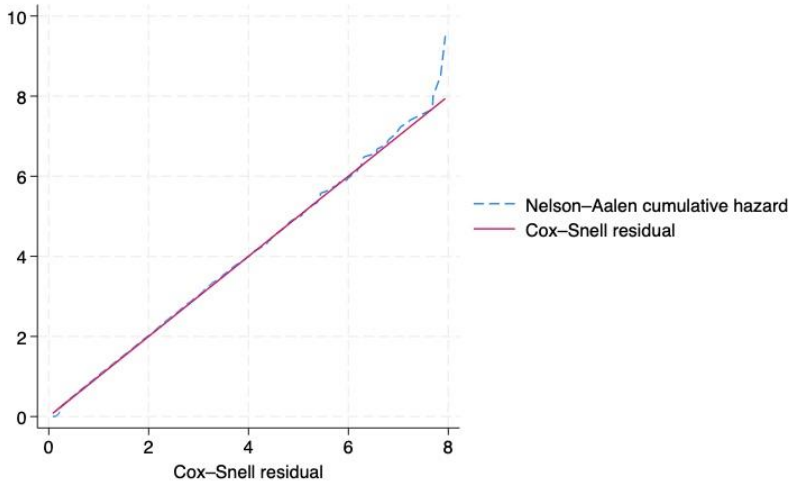

Figure 19. Goodness of Fit Test

Appendix 2: Impact of Client/System Characteristics

Table 24. Changes in IRR and AIC when Variable Added, Multilevel Mixed-Effects Model

	IRR (Mostly Virtual)	IRR (Hybrid)	AIC
Crude	1.196	2.917	55121.48
Age	1.198	2.903	55056.69
Sex	1.194	2.890	55020.78
Presenting Concern	1.194	2.895	54934.43
Urgent Stream	1.201	2.915	53394.05
Specific Partnership	1.163	2.615	52840.14
Clinic	1.171	2.625	52792.91
Time Period	1.113	2.468	47421.98

Table 25. Changes in IRR and AIC when Variable Added, Zero-Inflated Model

	IRR (Mostly Virtual)	IRR (Hybrid)	AIC
Crude	0.944	0.989	53971.98
Age	0.942	0.987	53943.86
Sex	0.942	0.987	53943.34
Presenting Concern	0.950	0.989	53847.44
Urgent Stream	0.948	0.993	52344.31
Specific Partnership	0.951	1.001	52325.51
Clinic	0.945	0.998	52284.96
Time Period	1.012	1.043	52214.94

Appendix 3: Sensitivity Analysis (180-Day Definition)

EPISODE MODALITY (180-DAY DEFINITION)

Table 26 summarizes the demographic, clinical, service, and health service use characteristics by episode modality (virtual, in-person, and hybrid) for the 180-day definition. With respect to the clinical characteristics, anxiety disorders were the most common presenting concerns among in-person episodes (n=939 (29%)) and hybrid episodes (n=464 (30%)). The mean HEADS-ED score was 6 for in-person (range: 1-13), virtual (range: 2-13), and hybrid (range: 2-14) episodes. Among in-person episodes, the mean episode length was 6 (range: 1-54) visits and 114 (range: 0-1,048) days. Virtual episodes had a mean episode length of 8 (range: 1-70) visits and 147 (range: 0-1,013) days. Among hybrid episodes, the mean episode length was 17 (range: 2-125) visits and 343 (range: 2-1655) days.

Table 26. Descriptive Characteristics of In-Person, Virtual, and Hybrid Episodes, 180-Day Definition

	Mostly In-Person n=3,192 episodes, (48%)	**Mostly Virtual n=1,857 episodes, (28%)**	**Hybrid n=1,563 episodes, (24%)**
Client Demographic Characteristics			
Age at first visit in episode, mean (min-max)	14 (3-21)	13 (4-20)	13 (4-20)
Age Category			
0-11	718 (23%)	503 (27%)	383 (25%)
12-18	2,456 (77%)	1,344 (73%)	1,179 (75%)
Over 18	18 (1%)	10 (1%)	1 (<1%)
Sex			
Males	1,336 (42%)	733 (39%)	597 (38%)
Females	1,856 (58%)	1,124 (61%)	966 (62%)
Client Clinical Characteristics			
Presenting Concern			
Substance Use and Related Disorders	157 (5%)	53 (3%)	52 (3%)
Mood Disorders	532 (17%)	188 (10%)	218 (14%)
Anxiety Disorders	939 (29%)	467 (25%)	464 (30%)
Personality Disorders	22 (1%)	7 (<1%)	10 (1%)
Eating and Other Feeding Disorders	33 (1%)	59 (3%)	30 (2%)
Other Mental Health Disorders	416 (13%)	283 (15%)	200 (13%)

	Mostly In-Person n=3,192 episodes, (48%)	Mostly Virtual n=1,857 episodes, (28%)	Hybrid n=1,563 episodes, (24%)
Neurodevelopmental Disorders	216 (7%)	91 (5%)	106 (7%)
Neurocognitive Disorders	8 (<1%)	2 (<1%)	0 (0%)
Trans Health	90 (3%)	50 (3%)	37 (2%)
To Be Determined	492 (15%)	542 (29%)	357 (23%)
Not Available	286 (9%)	115 (6%)	89 (6%)
HEADS-ED Score, mean (min-max)	6 (1-13) (n=1,846)	6 (2-13) (n=1,020)	6 (2-14) (n=897)
Service Characteristics			
Urgent Stream			
Urgent	151 (5%)	76 (4%)	81 (5%)
Non-Urgent	2,971 (95%)	1,690 (96%)	1,438 (95%)
Specific Partnership			
100% Core	2,875 (90%)	1,563 (84%)	1,175 (75%)
Core and Specific	315 (10%)	294 (16%)	388 (25%)
Clinic			
Halifax	809 (25%)	460 (25%)	425 (27%)
Dartmouth	695 (22%)	497 (27%)	394 (25%)
Sackville	745 (23%)	413 (22%)	333 (21%)
School	943 (30%)	487 (26%)	411 (26%)
Time Period			
Fiscal Year 2019/20	1,344 (47%)	7 (<1%)	271 (17%)
Fiscal Year 2020/21	186 (7%)	864 (47%)	463 (30%)
Fiscal Year 2021/22	417 (15%)	685 (37%)	478 (31%)
Fiscal Year 2022/23	891 (31%)	288 (16%)	340 (22%)
Health Service Use Characteristics			
Episode length, visits, mean (min-max)	6 (1-54)	8 (1-70)	17 (2-125)
Episode length, days, mean (min-max)	114 (0-1048)	147 (0-1013)	343 (2-1655)

EPISODES BY TIME PERIOD (180-DAY DEFINITION)

Table 27 summarizes the demographic, clinical, service, and health service use characteristics by time period. With respect to the clinical characteristics, anxiety disorders were the most common presenting concerns in Period 1 (n=460 (28%)), Period 3 (n=490 (31%)) and Period 4 (n=494 (33%)). The mean HEADS-ED score was 5 (range:

2-13) for Period 1, 6 (range: 2-14) for Period 2, 6 (range: 2-13) for Period 3, and 6 (range: 1-12) for Period 4. In Period 3, the proportion of episodes identified as urgent was the highest (n=85 (6%)) compared to other periods. The mean episode length in Period 2 (fiscal year 2020/21) was the longest relative to the other periods.

Table 28 summarizes the episode length by treatment modality during each time period, in terms of number of visits. The mostly in-person treatment modality had the lowest mean number of visits during Period 2 (mean=5). The mostly virtual treatment modality had the highest mean number of visits during Periods 2 and 3 (mean=8), except for Period 1 where there were very few mostly virtual episodes.

Table 29 summarizes the episode length by treatment modality during each time period, in terms of number of days. The mostly in-person treatment modality had the highest mean number of days during Period 1 (mean=132). The mostly virtual treatment modality had the highest mean number of days during Period 3 (mean=156), except for Period 1 where there were very few mostly virtual episodes.

Table 27. Descriptive Characteristics of Episodes by Time Period, 180-Day Definition

	Period 1 (Fiscal Year 2019/20) n=1,622 episodes, (26%)	**Period 2 (Fiscal Year 2020/21) n=1,513 episodes, (24%)**	**Period 3 (Fiscal Year 2021/22) n=1,580 episodes, (25%)**	**Period 4 (Fiscal Year 2022/23) n=1,519 episodes, (24%)**
Client Demographic Characteristics				
Age at first visit in episode, mean (min-max)	13 (3-20)	14 (4-20)	14 (4-20)	14 (4-21)
Age Category				
0-11	432 (27%)	379 (25%)	361 (23%)	356 (23%)
12-18	1,179 (73%)	1,129 (75%)	1,214 (77%)	1,159 (76%)
Over 18	11 (1%)	5 (<1%)	5 (<1%)	4 (<1%)
Sex				
Males	712 (44%)	630 (42%)	583 (37%)	585 (39%)
Females	910 (56%)	883 (58%)	997 (63%)	934 (61%)
Client Clinical Characteristics				

	Period 1 (Fiscal Year 2019/20) n=1,622 episodes, (26%)	Period 2 (Fiscal Year 2020/21) n=1,513 episodes, (24%)	Period 3 (Fiscal Year 2021/22) n=1,580 episodes, (25%)	Period 4 (Fiscal Year 2022/23) n=1,519 episodes, (24%)
Presenting Concern				
Substance Use and Related Disorders	90 (6%)	71 (5%)	35 (2%)	47 (3%)
Mood Disorders	339 (21%)	157 (10%)	204 (13%)	165 (11%)
Anxiety Disorders	460 (28%)	300 (20%)	490 (31%)	494 (33%)
Personality Disorders	7 (<1%)	4 (<1%)	11 (1%)	15 (1%)
Eating and Other Feeding Disorders	22 (1%)	34 (2%)	30 (2%)	31 (2%)
Other Mental Health Disorders	249 (15%)	191 (13%)	223 (14%)	197 (13%)
Neurodevelopmental Disorders	123 (8%)	57 (4%)	88 (6%)	121 (8%)
Neurocognitive Disorders	3 (<1%)	1 (<1%)	2 (<1%)	4 (<1%)
Trans Health	59 (4%)	39 (3%)	34 (2%)	33 (2%)
To Be Determined	3 (<1%)	486 (32%)	460 (29%)	407 (27%)
Not Available	267 (16%)	173 (11%)	3 (<1%)	5 (<1%)
HEADS-ED Score, mean (min-max)	5 (2-13) (n=947)	6 (2-14) (n=866)	6 (2-13) (n=880)	6 (1-12) (n=884)
Service Characteristics				
Urgent Stream				
Urgent	69 (4%)	54 (4%)	85 (6%)	79 (5%)
Non-Urgent	1,553 (96%)	1,396 (96%)	1,427 (94%)	1,374 (95%)
Specific Partnership				
100% Core	1,437 (89%)	1,234 (82%)	1,334 (84%)	1,263 (83%)
Core and Specific	185 (11%)	279 (18%)	246 (16%)	256 (17%)
Clinic				
Halifax	444 (27%)	393 (26%)	363 (23%)	385 (25%)
Dartmouth	401 (25%)	366 (24%)	398 (25%)	363 (24%)
Sackville	401 (25%)	321 (21%)	322 (20%)	358 (24%)
School	376 (23%)	433 (29%)	497 (31%)	413 (27%)
Health Service Use Characteristics				
Episode length, visits, mean (min-max)	9 (1-125)	11 (1-87)	9 (1-94)	8 (1-59)
Episode length, days, mean (min-max)	204 (0-1655)	214 (0-1150)	178 (0-1189)	150 (0-956)

	Period 1 (Fiscal Year 2019/20) n=1,622 episodes, (26%)	Period 2 (Fiscal Year 2020/21) n=1,513 episodes, (24%)	Period 3 (Fiscal Year 2021/22) n=1,580 episodes, (25%)	Period 4 (Fiscal Year 2022/23) n=1,519 episodes, (24%)
Episode Modality				
Mostly In-Person	1,344 (83%)	186 (12%)	417 (26%)	891 (59%)
Mostly Virtual	7 (<1%)	864 (57%)	685 (43%)	288 (19%)
Hybrid	271 (17%)	463 (31%)	478 (30%)	340 (22%)

Table 28. Episode Length in Visits by Treatment Modality, In Each Time Period, 180-Day Definition

	Episode Length, Visits			
	Period 1 (Fiscal Year 2019/20)	Period 2 (Fiscal Year 2020/21)	Period 3 (Fiscal Year 2021/22)	Period 4 (Fiscal Year 2022/23)
Mostly In-Person				
Mean (Min-Max)	6 (1-41)	5 (1-37)	6 (1-54)	6 (1-38)
Median (IQR)	5 (2-9)	3 (2-6)	4 (2-7)	5 (3-8)
n	1,344	186	417	891
Mostly Virtual				
Mean (Min-Max)	12 (1-30)	8 (1-70)	8 (1-50)	6 (1-46)
Median (IQR)	3 (1-26)	6 (3-11)	5 (3-10)	4 (2-8)
n	7	864	685	288
Hybrid				
Mean (Min-Max)	25 (2-125)	19 (2-87)	14 (2-94)	13 (2-59)
Median (IQR)	20 (10-35)	15 (9-27)	11 (7-18)	10.5 (7-16)
n	271	463	478	340
All Modalities				
Mean (Min-Max)	9 (1-125)	11 (1-87)	9 (1-94)	68(1-59)
Median (IQR)	6 (3-12)	8 (4-15)	6 (3-12)	6 (3-11)
n	1,622	1,513	1,580	1,519

Table 29. Episode Length in Days by Treatment Modality, In Each Time Period, 180-Day Definition

	Episode Length, Days			
	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
Mostly In-Person				
Mean (Min-Max)	132 (0-1048)	87 (0-867)	117 (0-899)	125 (0-833)
Median (IQR)	100 (35-196)	49.5 (14- 120)	77 (27-157)	98 (35-179)
n	1,344	186	417	891
Mostly Virtual				
Mean (Min-Max)	327 (0-853)	156 (0-1013)	149 (0-847)	120 (0-835)
Median (IQR)	31 (0-753)	119 (45-213.5)	105 (36-222)	85.5 (28-176)
n	7	864	685	288
Hybrid				
Mean (Min-Max)	557 (20-1655)	372 (6-1150)	272 (2-1189)	242 (4-956)
Median (IQR)	508 (267-812)	333 (177-511)	224 (140-374)	204.5 (130.5-329)
n	271	463	478	340
All Modalities				
Mean (Min-Max)	204 (0-1655)	214 (0-1150)	178 (0-1189)	150 (0-956)
Median (IQR)	126 (47-260)	148 (57-301)	130 (49-259.5)	116 (43-210)
n	1,622	1,513	1,580	1,519

EPISODES BY CLINIC (180-DAY DEFINITION)

Table 30 summarizes the demographic, clinical, service, and health service use characteristics for each clinic.

Table 30. Descriptive Characteristics of Episodes by Clinic, 180-Day Definition

	Dartmouth n=1,586 episodes, (24%)	**Halifax n=1,694 episodes, (26%)**	**Sackville n=1,490 episodes, (23%)**	**School n=1,842 episodes, (28%)**
Client Demographic Characteristics				
Age at first visit in episode, mean (min-max)	13 (3-21)	13 (3-20)	13 (3-18)	15 (4-20)
Age Category				
0-11	507 (32%)	518 (31%)	483 (32%)	96 (5%)
12-18	1,072 (68%)	1,165 (69%)	1,007 (68%)	1,735 (94%)

	Dartmouth n=1,586 episodes, (24%)	Halifax n=1,694 episodes, (26%)	Sackville n=1,490 episodes, (23%)	School n=1,842 episodes, (28%)
Over 18	7 (<1%)	11 (1%)	0 (<1%)	11 (1%)
Sex				
Males	669 (42%)	763 (45%)	611 (41%)	623 (34%)
Females	917 (58%)	931 (55%)	879 (59%)	1,219 (66%)
Client Clinical Characteristics				
Presenting Concern				
Substance Use and Related Disorders	78 (5%)	123 (7%)	28 (2%)	33 (2%)
Mood Disorders	253 (16%)	209 (12%)	184 (12%)	292 (16%)
Anxiety Disorders	578 (36%)	447 (26%)	367 (25%)	478 (26%)
Personality Disorders	11 (1%)	12 (1%)	11 (1%)	5 (<1%)
Eating and Other Feeding Disorders	29 (2%)	13 (1%)	47 (3%)	33 (2%)
Other Mental Health Disorders	395 (25%)	220 (13%)	205 (14%)	79 (4%)
Neurodevelopmental Disorders	142 (9%)	159 (9%)	70 (5%)	42 (2%)
Neurocognitive Disorders	4 (<1%)	4 (<1%)	1 (<1%)	1 (<1%)
Trans Health	29 (2%)	50 (3%)	15 (1%)	83 (5%)
To Be Determined	62 (4%)	339 (20%)	373 (25%)	617 (33%)
Not Available	5 (<1%)	118 (7%)	189 (13%)	179 (10%)
HEADS-ED Score, mean (min-max)	6 (2-13) (n=819)	6 (2-13) (n=831)	5 (1-14) (n=911)	6 (2-13) (n=1,202)
Service Characteristics				
Urgent Stream				
Urgent	130 (8%)	106 (7%)	53 (4%)	19 (1%)
Non-Urgent	1,415 (92%)	1,520 (93%)	1,389 (96%)	1,774 (99%)
Specific Partnership				
100% Core	1,242 (78%)	1,445 (85%)	1,306 (88%)	1,622 (88%)
Core and Specific	344 (22%)	249 (15%)	184 (12%)	220 (12%)
Health Service Use Characteristics				
Episode length, visits, mean (min-max)	9 (1-87)	8 (1-110)	10 (1-105)	9 (1-125)
Episode length, days, mean (min-max)	187 (0-1250)	192 (0-1440)	181 (0-1334)	172 (0-1665)
Episode Modality				
Mostly In-Person	695 (44%)	809 (48%)	745 (50%)	943 (51%)

	Dartmouth n=1,586 episodes, (24%)	Halifax n=1,694 episodes, (26%)	Sackville n=1,490 episodes, (23%)	School n=1,842 episodes, (28%)
Mostly Virtual	497 (31%)	460 (27%)	413 (28%)	487 (26%)
Hybrid	394 (25%)	425 (25%)	332 (22%)	412 (22%)

Table 31 summarizes the episode length by treatment modality in each clinic, in terms of number of visits. Episodes that took place within the Sackville clinic had the highest mean and median number of visits for the mostly in-person modalities.

Table 32 summarizes the episode length by treatment modality in each clinic, in terms of number of days. Episodes within the Sackville clinic had the highest mean and median number of days for the mostly in-person modality, whereas episodes within the Dartmouth clinic had the highest mean and median number of days for the mostly virtual modality.

Table 31. Episode Length in Visits by Treatment Modality, by Clinic, 180-Day Definition

	Episode Length, Visits			
	Dartmouth	**Halifax**	**Sackville**	**School**
Mostly In-Person				
Mean (Min-Max)	6 (1-54)	5 (1-29)	7 (1-32)	6 (1-41)
Median (IQR)	4 (2-7)	4 (2-7)	5 (3-9)	4 (2-7)
n	695	809	745	943
Mostly Virtual				
Mean (Min-Max)	8 (1-50)	8 (1-53)	8 (1-70)	7 (1-50)
Median (IQR)	6 (3-10)	5 (3-10)	6 (3-12)	4 (2-9)
n	497	460	413	487
Hybrid				
Mean (Min-Max)	17 (2-87)	16 (2-110)	18 (2-105)	18 (2-125)
Median (IQR)	13 (8-22)	11 (7-21)	14 (8.5-24)	13.5 (8-24)
n	394	425	332	412
All Modalities				
Mean (Min-Max)	9 (1-87)	8 (1-110)	10 (1-105)	9 (1-125)
Median (IQR)	6 (3-12)	6 (3-11)	7 (4-12)	5 (2-11)
n	1,586	1,694	1,490	1,842

Table 32. Episode Length in Days by Treatment Modality, by Clinic, 180-Day Definition

	Episode Length, Days			
	Dartmouth	**Halifax**	**Sackville**	**School**
Mostly In-Person				
Mean (Min-Max)	120 (0-899)	104 (0-709)	124 (0-651)	112 (0-1048)
Median (IQR)	84 (23-175)	70 (14-153)	96 (38-178)	77 (18-161)
n	695	809	745	943
Mostly Virtual				
Mean (Min-Max)	160 (0-948)	153 (0-1013)	147 (0-753)	129 (0-849)
Median (IQR)	125 (49-217)	99.5 (34-217.5)	113 (43-212)	80 (20-177)
n	497	460	413	487
Hybrid				
Mean (Min-Max)	339 (4-1239)	322 (8-1440)	352 (8-1334)	362 (2-1665)
Median (IQR)	266.5 (149-488)	259 (147-434)	280 (160.5-452.5)	300 (157-488)
n	394	425	332	412
All Modalities				
Mean (Min-Max)	187 (0-1250)	172 (0-1440)	181 (0-1334)	172 (0-1665)
Median (IQR)	132 (50-255)	112 (36-238)	131 (56-246)	106 (33-238)
n	1,586	1,694	1,490	1,842

CATEGORISING EPISODE LENGTH (180-DAY DEFINITION)

Table 33 summarizes the demographic, clinical, service, and health service use characteristics by groupings of episode lengths. With respect to the clinical characteristics, anxiety disorders were the most common presenting concern among all groups. Around 44% of the episodes in the long category consist of both Core and Specific Partnership visits (n=323). The in-person modality was the most common modality for the short (n=574 (69%)) and medium (below average) (n=1,946 (57%)). The most common modality for the long category was hybrid (n=513 (69%)).

Table 33. Descriptive Characteristics of Short, Medium, and Long Episodes,180-Day Definition

	Short Episodes (1 visit) n=833 episodes, (13%)	**Medium (Below Average) Episodes (2-8 visits) n=3,417 episodes, (52%)**	**Medium (Above Average) Episodes (9-18 visits) n=1,622 episodes, (25%)**	**Long Episodes (19+ visits) n=740 episodes, (11%)**
Demographic Characteristics				
Age at first visit in episode, mean (min-max)	14 (4-21)	14 (3-20)	14 (3-18)	13 (4-18)
Age Category				
0-11	183 (22%)	872 (26%)	386 (24%)	163 (22%)
12-18	636 (76%)	2,530 (74%)	1,236 (76%)	577 (78%)
Over 18	14 (2%)	15 (<1%)	0 (<1%)	0 (<1%)
Sex				
Males	363 (44%)	1,443 (42%)	609 (38%)	251 (34%)
Females	470 (56%)	1,974 (58%)	1,013 (62%)	489 (66%)
Clinical Characteristics				
Presenting Concern				
Substance Use and Related Disorders	48 (6%)	142 (4%)	51 (3%)	21 (3%)
Mood Disorders	112 (13%)	482 (14%)	241 (15%)	103 (14%)
Anxiety Disorders	212 (25%)	962 (28%)	482 (30%)	214 (29%)
Personality Disorders	5 (1%)	21 (1%)	9 (1%)	4 (1%)
Eating and Other Feeding Disorders	4 (<1%)	33 (1%)	50 (3%)	35 (5%)
Other Mental Health Disorders	109 (13%)	485 (14%)	202 (12%)	103 (14%)
Neurodevelopmental Disorders	45 (5%)	225 (7%)	95 (6%)	48 (6%)
Neurocognitive Disorders	4 (<1%)	4 (<1%)	1 (<1%)	1 (<1%)
Trans Health	46 (6%)	87 (3%)	21 (1%)	23 (3%)
To Be Determined	178 (21%)	735 (22%)	349 (22%)	129 (17%)
Not Available/ Missing	70 (8%)	241 (7%)	121 (7%)	59 (8%)
HEADS-ED Score, mean (min-max)	6 (2-12) (n=402)	6 (1-13) (n=2,038)	6 (2-13) (n=927)	6 (2-14) (n=396)
Service Characteristics				
Urgent Stream				
Urgent	28 (4%)	151 (5%)	93 (6%)	36 (5%)
Non-Urgent	772 (96%)	3,161 (95%)	1,481 (94%)	685 (95%)

	Short Episodes (1 visit) n=833 episodes, (13%)	Medium (Below Average) Episodes (2-8 visits) n=3,417 episodes, (52%)	Medium (Above Average) Episodes (9-18 visits) n=1,622 episodes, (25%)	Long Episodes (19+ visits) n=740 episodes, (11%)
Specific Partnership				
100% Core	746 (90%)	3,102 (91%)	1,350 (83%)	417 (56%)
Core and Specific	87 (10%)	315 (9%)	272 (17%)	323 (44%)
Clinic				
Halifax	238 (29%)	889 (26%)	387 (24%)	180 (24%)
Dartmouth	184 (22%)	814 (24%)	404 (25%)	184 (25%)
Sackville	133 (16%)	747 (22%)	438 (27%)	173 (23%)
School	278 (33%)	967 (28%)	393 (24%)	203 (27%)
Time Period				
Fiscal Year 2019/20	205 (30%)	848 (27%)	380 (24%)	189 (26%)
Fiscal Year 2020/21	139 (20%)	682 (21%)	426 (26%)	266 (36%)
Fiscal Year 2021/22	175 (25%)	813 (26%)	420 (26%)	172 (23%)
Fiscal Year 2022/23	170 (25%)	846 (27%)	390 (24%)	113 (15%)
Health Service Use				
Episode Modality				
Mostly In-Person	574 (69%)	1,948 (57%)	581 (36%)	89 (12%)
Mostly Virtual	259 (31%)	998 (29%)	462 (28%)	138 (19%)
Hybrid	0 (0%)	471 (14%)	579 (36%)	513 (69%)

RATIO OF DAYS TO VISITS (180-DAY DEFINITION)

Table 34 presents the ratio of days to visits for each time period by treatment modality. For all modalities, the mean ratio of days to visits was the highest in Period 1 (19.25 (range: 0-87.5) and the smallest in Period 4 (17.54 (range: 0-81.5)). For the in-person modality, the ratio was highest during Period 1 (18.15 (range: 0-87.5)) and lowest in Period 2 (13.95 (range: 0-58.5)). For the virtual modality, the period with the lowest ratio, excluding Period 1 as there were very few virtual episodes within this time period, was Period 4 (16.18 (range: 0-51)) and Period 3 had the highest ratio (17.05 (range: 0-80))

Figure 20 presents histograms of the days-to-visit ratio for each time period.

Table 34. Ratio of Days to Visits per Episode, by Time Period and Treatment Modality 180-Day Definition

Days/Visits				
	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
Mostly In-Person				
Mean (Min–Max)	18.15 (0- 87.5)	13.95 (0- 58.5)	17.41 (0-84)	17.16 (0-81.5)
Median (IQR)	17.70 (10.93-24.8)	13.15 (7-20.86)	15.97 (9-24.18)	17 (10.67-23.33)
n	1,344	186	417	891
Mostly Virtual				
Mean (Min–Max)	15.01 (0-28.96)	16.67 (0-64.67)	17.05 (0-80)	16.18 (0-51)
Median (IQR)	10.33 (0-28.43)	16.65 (10.84-21.81)	16.5 (10.5-23.29)	16.33 (8.13-23.39)
n	7	864	685	288
Hybrid				
Mean (Min–Max)	24.80 (9-69)	20.81 (3-72)	21.24 (1-84)	19.69 (2-53.33)
Median (IQR)	23.12 (18.64-28.44)	19.45 (15.43-25)	19.83 (15.32-25.19)	18.25 (13.72-24.23)
n	271	463	478	340
All Modalities				
Mean (Min–Max)	19.25 (0-87.5)	17.60 (0-72)	18.41 (0-84)	17.54 (0-81.5)
Median (IQR)	19 (12.5-25.5)	17.32 (11.53-22.75)	17.5 (12-23.95)	17.5 (11-23.5)
n	1,622	1,513	1,580	1,519

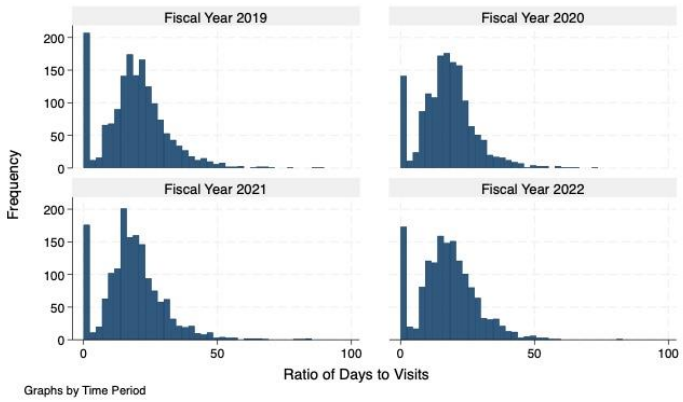

Figure 20. Histogram of Days/Visits, by Time Period

EPISODES WITH AND WITHOUT HEADS-ED SCORE (180-DAY DEFINITION)

Table 35 displays the descriptive statistics results of the episodes with and without a HEADS-ED score, for the 180-day rule. The variables that demonstrated a difference between the two groups were the age, urgent stream, Specific Partnership, and clinic variables.

Table 35. Descriptive Statistics of Episodes With and Without a HEADS-ED Score, 180-Day Definition

	Episodes Without HEADS-ED Score n=2,849 episodes, (43%)	**Episodes With HEADS-ED Score n=3,763 episodes, (57%)**
Client Demographic Characteristics		
Age of client at first visit in episode, mean (min-max)	14 (4-21)	13 (3-19)
Age Category		
0-11	502 (18%)	1,102 (29%)
12-18	2,324 (82%)	2,655 (71%)
Over 18	23 (1%)	6 (<1%)
Sex		
Males	1,052 (37%)	1,614 (43%)
Females	1,797 (63%)	2,149 (57%)
Client Clinical Characteristics		
Presenting Concern at first visit in episode		
Substance Use and Related Disorders	131 (5%)	131 (3%)
Mood Disorders	490 (17%)	448 (12%)

	Episodes Without HEADS-ED Score n=2,849 episodes, (43%)	Episodes With HEADS-ED Score n=3,763 episodes, (57%)
Anxiety Disorders	739 (26%)	1,131 (30%)
Personality Disorders	26 (1%)	13 (<1%)
Eating and Other Feeding Disorders	106 (4%)	16 (<1%)
Other Mental Health Disorders	397 (14%)	502 (13%)
Neurodevelopmental Disorders	131 (5%)	282 (7%)
Neurocognitive Disorders	4 (<1%)	6 (<1%)
Trans Health	151 (5%)	26 (1%)
To Be Determined	501 (18%)	890 (24%)
Not Available	173 (6%)	318 (8%)
Service Characteristics		
Urgent Stream		
Urgent	259 (10%)	49 (1%)
Non-Urgent	2,422 (90%)	3,676 (99%)
Specific Partnership		
100% Core	2,229 (78%)	3,386 (90%)
Core and Specific	620 (22%)	377 (10%)
Clinic		
Halifax	863 (30%)	831 (22%)
Dartmouth	767 (27%)	819 (22%)
Sackville	579 (20%)	911 (24%)
School	640 (22%)	1,202 (32%)
Time Period		
Fiscal Year 2019/20	675 (25%)	947 (26%)
Fiscal Year 2020/21	647 (24%)	866 (24%)
Fiscal Year 2021/22	700 (26%)	880 (25%)
Fiscal Year 2022/23	635 (24%)	884 (25%)
Health Service Use Characteristics		
Episode length, visits, mean (min-max)	9 (1-125)	9 (1-85)
Episode length, visits, median (IQR)	6 (2-12)	6 (3-11)
Episode length, days, mean (min-max)	176 (0-1655)	179 (0-1505)
Episode length, days, median (IQR)	117 (34-240)	120 (49-245)
Episode Modality		
Mostly In-Person	1,346 (47%)	1,846 (49%)
Mostly Virtual	837 (29%)	1,020 (27%)
Hybrid	666 (23%)	897 (24%)

Appendix 4: Sensitivity Analyses (HEADS-ED Score)

MULTILEVEL MIXED-EFFECTS NEGATIVE BINOMIAL MODEL

Table 36 represents the adjusted multilevel mixed-effects negative binomial model limited to episodes with a HEADS-ED score, for all time periods except for Period 1 as this model was unable to converge. In Period 2, the IRR for both the virtual (IRR = 1.38; CI: 1.18, 1.61) and hybrid (IRR = 2.20; CI: 1.88, 2.59) modalities was the highest. These results were significant as the p-values were less than 0.01, and the 95% confidence intervals did not cross 1.

Table 36. Adjusted Negative Binomial Multilevel Mixed-Effects Model, Restricted to Episodes with HEADS-ED Score

	Period 2 (Fiscal Year 2020/21)	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)
Treatment Modality			
Mostly In-Person (Reference)			
Mostly Virtual	1.38 (1.18, 1.61) **	1.26 (1.12, 1.41) **	0.79 (0.69, 0.90) **
Hybrid	2.20 (1.88, 2.59) **	1.82 (1.62, 2.05) **	1.46 (1.31, 1.62) **
Age			
0-11 (Reference)			
12-18	1.08 (0.97, 1.20)	1.11 (0.99, 1.24)	0.99 (0.89, 1.11)
Over 18	0.43 (0.16, 1.18)	0.89 (0.37, 2.12)	1 (empty)
Sex			
M (Reference)			
F	1.11 (1.02, 1.22)	1.10 (1.00, 1.21) *	1.15 (1.05, 1.27) **
Presenting Concern			
Substance Use and Related Disorders (Reference)			
Mood Disorders	0.94 (0 .70, 1.24)	1.32 (0.84, 2.06)	1.36 (0.99, 1.87)
Anxiety Disorders	1.01 (0.77, 1.32)	1.24 (0.80, 1.90)	1.29 (0.95, 1.73)
Personality Disorders	1 (empty)	1.20 (0.54, 2.64)	0.75 (0.42, 1.37)
Eating and Other Feeding Disorders	0.64 (0.30, 1.36)	1.50 (0.67, 3.33)	1.37 (0.78, 2.42)
Other Mental Health Disorders	1.03 (0.78, 1.35)	1.20 (0.78, 1.86)	1.28 (0.93, 1.74)

	Period 2 (Fiscal Year 2020/21)	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)
Neurodevelopmental Disorders	0.96 (0.68, 1.35)	1.21 (0.77, 1.90)	1.24 (0.89, 1.71)
Neurocognitive Disorders	1.49 (0.51, 4.34)	1.39 (0.39, 4.93)	1.80 (0.79, 4.10)
Trans Health	1 (empty)	1.11 (0.56, 2.19)	0.64 (0.26, 1.61)
To Be Determined	0.78 (0.60, 1.02)	1.36 (0.88, 2.09)	1.25 (0.92, 1.70)
Not Available	1.01 (0.76, 1.35)	0.63 (0.23, 1.71)	1.08 (0.44, 2.64)
Urgent Stream			
Urgent (Reference)			
Non-Urgent	1.32 (0.86, 2.02)	0.75 (0.53, 1.07)	0.88 (0.70, 1.12)
Specific Partnership			
Core (Reference)			
Core and Specific	1.41 (1.20, 1.67) **	1.42 (1.21, 1.68) **	1.56 (1.36, 1.79) **
Clinic			
Dartmouth (Reference)			
Halifax	1.02 (0.88, 1.18)	0.99 (0.86, 1.14)	1.03 (0.90, 1.17)
Sackville	1.11 (0.96, 1.28)	1.01 (0.88, 1.17)	1.10 (0.96, 1.25)
School	0.94 (0.82, 1.07)	0.88 (0.76, 1.01)	1.06 (0.93, 1.21)
Constant	3.53 (2.08, 5.99) **	4.95 (2.80, 8.74) **	4.93 (3.36, 7.23) **
Variance Between Individuals	0.18 (0.15, 0.22)	0.20 (0.16, 0.23)	0.19 (0.16, 0.23)

Note: * indicates p-value<0.05 ** indicates p-value<0.01

Table 37 describes the multilevel mixed-effects negative binomial model restricted to episodes with a HEADS-ED score and adjusting for HEADS-ED score. In Period 2, the IRR for both the virtual (IRR = 1.37; CI: 1.18, 1.60; p<0.01) and hybrid (IRR = 2.19; CI: 1.87, 2.58; p<0.01) modalities was the highest.

Table 37. Adjusted Negative Binomial Multilevel Mixed-Effects Model, Restricted to Episodes with HEADS-ED Score, Adjusted for HEADS-ED Score

	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)
Treatment Modality				
Mostly In-Person (Reference)				
Mostly Virtual	0.44 (0.10, 1.94)	1.37 (1.18, 1.60) **	1.26 (1.12, 1.41) **	0.79 (0.69, 0.90) **
Hybrid	1.51 (1.31, 1.73) **	2.19 (1.87, 2.58) **	1.82 (1.62, 2.05) **	1.46 (1.32, 1.62) **
Age				
0-11 (Reference)				
12-18	1.16 (1.04, 1.29) **	1.08 (0.98, 1.20)	1.11 (0.99, 1.24)	1.02 (0.91, 1.13)
Over 18	0.47 (0.11, 2.05)	0.44 (0.16, 1.20)	0.90 (0.38, 2.16)	1 (empty)
Sex				
M (Reference)				
F	1.05 (0.96, 1.14)	1.11 (1.01, 1.21)	1.10 (1.00, 1.21) *	1.15 (1.05, 1.26) **
Presenting Concern				
Substance Use and Related Disorders (Reference)				
Mood Disorders	1.16 (0.93, 1.44)	0.92 (0.69, 1.23)	1.31 (0.84, 2.05)	1.29 (0.94, 1.77)
Anxiety Disorders	1.22 (0.98, 1.50)	1.00 (0.76, 1.31)	1.22 (0.79, 1.89)	1.21 (0.90, 1.63)
Personality Disorders	1.75 (1.79, 3.89)	1 (empty)	1.18 (0.53, 2.62)	0.70 (0.38, 1.26)
Eating and Other Feeding Disorders	2.38 (0.96, 5.89)	0.62 (0.29, 1.32)	1.49 (0.67, 3.31)	1.29 (0.73, 2.26)
Other Mental Health Disorders	1.17 (0.93, 1.47)	1.01 (0.77, 1.34)	1.19 (0.77, 1.85)	1.21 (0.89, 1.66)
Neurodevelopmental Disorders	1.22 (0.95, 1.55)	0.95 (0.67, 1.34)	1.20 (0.76, 1.89)	1.19 (0.86, 1.65)
Neurocognitive Disorders	0.89 (0.25, 3.24)	1.47 (0.51, 4.27)	1.38 (0.39, 4.89)	1.69 (0.75, 3.84)

	Period 1 (Fiscal Year 2019/20)	**Period 2 (Fiscal Year 2020/21)**	**Period 3 (Fiscal Year 2021/22)**	**Period 4 (Fiscal Year 2022/23)**
	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)	IRR (95% Confidence Interval)
Trans Health	1.28 (0.78, 2.10)	1 (empty)	1.10 (0.56, 2.18)	0.61 (0.24, 1.51)
To Be Determined	1.00 (0.39, 2.55)	0.77 (0.59, 1.01)	1.34 (0.87, 2.08)	1.19 (0.88, 1.62)
Not Available	1.08 (0.86, 1.35)	1.00 (0.75, 1.33)	0.63 (0.23, 1.69)	0.92 (0.38, 2.27)
HEADS-ED Score	1.00 (0.97, 1.03)	0.99 (0.96, 1.02)	0.99 (0.97, 1.02)	0.96 (0.94, 0.99) **
Urgent Stream				
Urgent (Reference)				
Non-Urgent	0.84 (0.50, 1.43)	1.30 (0.85, 2.00)	0.74 (0.52, 1.06)	0.84 (0.67, 1.06)
Specific Partnership				
Core (Reference)				
Core and Specific	1.40 (1.19, 1.68) **	1.41 (1.20, 1.66) **	1.43 (1.21, 1.68) **	1.55 (1.36, 1.78) **
Clinic				
Dartmouth (Reference)				
Halifax	0.86 (0.75, 0.98) *	1.02 (0.88, 1.18)	0.99 (0.86, 1.14)	1.02 (0.89, 1.16)
Sackville	1.18 (1.05, 1.34) **	1.11 (0.96, 1.27)	1.01 (0.88, 1.16)	1.09 (0.96, 1.24)
School	1.04 (0.91, 1.19)	0.94 (0.82, 1.07)	0.88 (0.76, 1.01)	1.04 (0.91, 1.19)
Constant	5.33 (2.90, 9.78) **	3.88 (2.20, 6.85) **	5.20 (2.79, 9.68) **	6.80 (4.40, 10.52) **
Variance Between Individuals	0.21 (0.18, 0.25)	0.18 (0.15, 0.22)	0.20 (0.16, 0.23)	0.18 (0.15, 0.22)

Note: * indicates p-value<0.05 ** indicates p-value<0.01

ZERO-INFLATED NEGATIVE BINOMIAL MODEL

Table 38 represents the adjusted zero-inflated negative binomial model limited to episodes with a HEADS-ED score. The IRR for the virtual modality was 1.04 (CI: 1.00, 1.08; p<0.01). The IRR for the hybrid modality was 1.08 (CI: 1.04, 1.12; p<0.01).

Table 38. Zero-Inflated Negative Binomial Model, Restricted to Episodes with HEADS-ED Score

	IRR	95% Confidence Interval
Treatment Modality		
Mostly In-Person (Reference)		
Mostly Virtual	1.04	1.00, 1.08
Hybrid	1.08 **	1.04, 1.12
Age		
0-11 (Reference)		
12-18	0.97	0.94, 1.00
Over 18	0.84	0.60, 1.17
Presenting Concern		
Substance Use and Related Disorders (Reference)		
Mood Disorders	1.03	0.95, 1.12
Anxiety Disorders	1.06	0.99, 1.15
Personality Disorders	0.94	0.75, 1.18
Eating and Other Feeding Disorders	1.07	0.87, 1.31
Other Mental Health Disorders	1.04	0.96, 1.13
Neurodevelopmental Disorders	1.07	0.98, 1.17
Neurocognitive Disorders	0.76	0.53, 1.08
Trans Health	1.42 **	1.17, 1.74
To Be Determined	1.08	0.99, 1.17
Not Available	1.06	0.97, 1.16
Urgent Stream		
Urgent (Reference)		
Non-Urgent	1.06	0.95, 1.18
Specific Partnership		
Core (Reference)		
Core and Specific	0.93 **	0.89, 0.97
Clinic		
Dartmouth (Reference)		
Halifax	0.95 *	0.91, 0.99
Sackville	0.92 **	0.89, 0.96
School	0.90 **	0.87, 0.94
Time Period		
Fiscal Year 2019/20 (Reference)		
Fiscal Year 2020/21	0.86 **	0.82, 0.90
Fiscal Year 2021/22	0.93 **	0.89, 0.97
Fiscal Year 2022/23	0.94 **	0.91, 0.98
Constant	18.92**	16.54, 21.64

Zero-Inflation of Model	Coefficient	95% Confidence Interval
Treatment Modality		
Mostly Virtual	0.48 **	0.24, 0.71
Presenting Concern		
Trans Health	1.31	-0.01, 2.62
Specific Partnership		
Core and Specific	-1.21 **	-1.81, -0.61
Clinic		
Sackville	-0.53 **	-0.83, -0.23
Time Period		
Period 4	0.18	-0.09, 0.44
Constant	-2.23 **	-2.40, -2.06

Note: * indicates p-value<0.05 ** indicates p-value<0.01

Table 39 describes the zero-inflated negative binomial model restricted to episodes with a HEADS-ED score and adjusting for HEADS-ED score. The IRR for the virtual modality was 1.04 (CI: 1.00, 1.08). The IRR for the hybrid modality was 1.08 (CI: 1.04, 1.12; p<0.01).

Table 39. Zero-Inflated Negative Binomial Model, Restricted to Episodes with HEADS-ED Score, Adjusting for HEADS-ED Score

	IRR	95% Confidence Interval
Treatment Modality		
Mostly In-Person (Reference)		
Mostly Virtual	1.04	1.00, 1.08
Hybrid	1.08 **	1.04, 1.12
Age		
0-11 (Reference)		
12-18	0.97	0.94, 1.01
Over 18	0.86	0.62, 1.21
Presenting Concern		
Substance Use and Related Disorders (Reference)		
Mood Disorders	1.00	0.92, 1.08
Anxiety Disorders	1.03	0.95, 1.11
Personality Disorders	0.91	0.73, 1.14
Eating and Other Feeding Disorders	1.03	0.83, 1.26
Other Mental Health Disorders	1.01	0.93, 1.10
Neurodevelopmental Disorders	1.04	0.96, 1.14

	IRR	95% Confidence Interval
Neurocognitive Disorders	0.74	0.52, 1.05
Trans Health	1.36 **	1.11, 1.66
To Be Determined	1.04	0.96, 1.13
Not Available	1.03	0.94, 1.12
HEADS-ED Score	0.99 **	0.98, 0.99
Urgent Stream		
Urgent (Reference)		
Non-Urgent	1.04	0.94, 1.16
Specific Partnership		
Core (Reference)		
Core and Specific	0.93 **	0.89, 0.97
Clinic		
Dartmouth (Reference)		
Halifax	0.95 **	0.91, 0.99
Sackville	0.92 **	0.88, 0.96
School	0.90 **	0.87, 0.94
Time Period		
Fiscal Year 2019/20 (Reference)		
Fiscal Year 2020/21	0.87 **	0.83, 0.91
Fiscal Year 2021/22	0.94 **	0.90, 0.98
Fiscal Year 2022/23	0.95 **	0.91, 0.99
Constant	21.37 **	18.41, 24.82
Zero-Inflation of Model	Coefficient	95% Confidence Interval
Treatment Modality		
Virtual Modality	0.49 **	0.24, 0.71
Presenting Concern		
Trans Health	1.31	-0.01, 2.62
Specific Partnership		
Core and Specific	-1.21 **	-1.81, -0.61
Clinic		
Sackville	-0.53 **	-0.83, -0.23
Time Period		
Period 4	0.148	-0.09, 0.44
Constant	-2.23	-2.40, -2.06

Note: * indicates p-value<0.05 ** indicates p-value<0.01

TIME-TO-EVENT ANALYSIS

Table 40 represents the adjusted Cox Proportional Hazards model limited to episodes with a HEADS-ED score. The adjusted model indicates that at time t, the hazard ratio was 0.83 (CI: 0.77, 0.91; p<0.01) times lower in virtual episodes compared to in-person episodes.

Table 40. Adjusted Cox Proportional Hazards Model, Restricted to Episodes with a HEADS-ED Score

	Hazard Ratio (95% CI)	**P>|Z|**	**Std. Error**
Modality			
Mostly In-Person (Reference)			
Mostly Virtual	0.83 (0.77, 0.91)	0.000	0.037
Sex			
M (Reference)			
F	0.91 (0.84, 0.99)	0.025	0.037
Presenting Concern			
Substance Use and Related Disorders (Reference)			
Mood Disorders	0.78 (0.62, 0.98)	0.032	0.091
Anxiety Disorders	0.76 (0.61, 0.94)	0.013	0.083
Personality Disorders	1.74 (0.87, 3.45)	0.116	0.608
Eating and Other Feeding Disorders	0.92 (0.50, 1.68)	0.786	0.284
Other Mental Health Disorders	0.86 (0.68, 1.08)	0.186	0.099
Neurodevelopmental Disorders	0.80 (0.63, 1.02)	0.078	0.100
Neurocognitive Disorders	0.75 (0.31, 1.86)	0.540	0.347
Trans Health	0.84 (0.48, 1.47)	0.547	0.239
To Be Determined	0.81 (0.65, 1.00)	0.059	0.092
Not Available	0.81 (0.63, 1.03)	0.080	0.099

Table 41 describes the Cox Proportional Hazards model restricted to episodes with a HEADS-ED score and adjusting for HEADS-ED score. The adjusted model indicates that at time t, the hazard ratio was 0.83 (CI: 0.76, 0.90; p<0.01) times lower in virtual episodes compared to in-person episodes.

Table 41. Adjusted Cox Proportional Hazards Model, Restricted to Episodes with a HEADS-ED Score, Adjusted for HEADS-ED Score

	Hazard Ratio (95% CI)	**P>|Z|**	**Std. Error**
Modality			
Mostly In-Person (Reference)			
Mostly Virtual	0.83 (0.76, 0.90)	0.000	0.036
Sex			
M (Reference)			
F	0.91 (0.84, 1.00)	0.029	0.038
Presenting Concern			
Substance Use and Related Disorders (Reference)			
Mood Disorders	0.84 (0.66, 1.06)	0.147	0.101
Anxiety Disorders	0.83 (0.67, 1.04)	0.101	0.094
Personality Disorders	1.86 (0.93, 3.69)	0.078	0.652
Eating and Other Feeding Disorders	1.00 (0.54, 1.84)	1.00	0.310
Other Mental Health Disorders	0.92 (0.73, 1.17)	0.504	0.109
Neurodevelopmental Disorders	0.87 (0.68, 1.12)	0.292	0.111
Neurocognitive Disorders	0.85 (0.34, 2.10)	0.725	0.392
Trans Health	0.94 (0.54, 1.64)	0.821	0.267
To Be Determined	0.87 (0.69, 1.09)	0.238	0.101
Not Available	0.88 (0.69, 1.13)	0.319	0.111
HEADS-ED Score	1.04 (1.01, 1.06)	0.001	0.012

Appendix 5: Variable Dictionary

Table 42. Variable Dictionary

Variable	Description	Measurement	Including?	Excluding?
Unique Study ID	Study ID given to client	Categorical	Used to create episodes of care	
New	New to MHA (Y/N)	Binary		"N" for all Partnership visits
ApptDt	Date of appointment	Continuous	Used to create episodes of care	
Status	Attended, cancelled, etc.	Categorical	Used to create episodes of care	
ApptDesc	ChoicePlus/ Partnership	Categorical	Used to exclude Choice Visits	
TxCategory	Type of Partnership visits (Core/Specific)	Binary	System characteristic, covariate	
PrimClinical Complaint	Presenting concern	Categorical	Client characteristic, covariate	
Partnership Type	Type of Partnership visits (Core/Specific)	Binary	System characteristic, covariate	
Specific Partnership TxType	Type of Specific Partnership visits (FAM THR Cl, REC THER, SPEC PART)	Categorical		Did not consider type of Specific Partnership Visits
First Partnership	First Partnership (Y/N)	Binary		Did not consider first Partnership visit in dataset
NewTxType	New type of treatment, for a separate or affiliated concern (Y/N)	Binary		Did not consider if new treatment type was initiated
ChoiceDt	Date of Choice appointment	Continuous		Did not consider Choice visits
NewTxType RequestDate	Date of new treatment type request			Did not consider if new treatment type was initiated

Variable	Description	Measurement	Including?	Excluding?
Priority Partnership	Priority Partnership (Y/N)	Binary	System characteristic, covariate, used to create "Urgent Variable"	
NewTxType Urgency	Urgency of visit (Non-urg 14,28,60,90, Urgent 7)	Categorical	System characteristic, covariate, used to create "Urgent Variable"	
Age	Age of client in years	Continuous	Client characteristic, covariate	
Gender	Sex of client (M/F)	Binary	Client characteristic, covariate	
Res Code	Residential code of client	Categorical		Did not consider client's location
DOB Month	Month of date of birth	Continuous		Did not consider DOB month, used age instead
DOB Year	Year of date of birth	Continuous		Did not consider DOB year, used age instead
Duration	Duration of visit (30, 60, 90, 120)	Categorical		Did not consider length of visit, majority of visits were "60"
ArrivedBy	Method of arrival	Categorical	Used to create treatment modality variable	
Location of Care	Location of care	Categorical	Used to create treatment modality variable	
Clinic	Clinic of visits	Categorical	System characteristic, covariate	

Variable	Description	Measurement	Including?	Excluding?
HEADS-ED Score	Total HEADS-ED Score at intake	Continuous	Client characteristic, covariate	
Referral Date	Date of referral	Continuous		Did not consider date of referral
Referred By	(Crisis, Parent, School, Self, etc..)	Categorical		Did not consider referral type