

**UNDERSTANDING THE USE OF MOBILE HEALTH (MHEALTH) TO
INCREASE MENTAL HEALTH CARE SERVICE ACCESS FOR YOUTH**

by

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Abstract

Background. Seventy-five percent of people with mental health disorders have an onset of illness between 12 and 24 years old. Many in this age group report significant obstacles to receiving quality youth-centred mental health care services. With the rapid development of technology and the advent of the COVID-19 pandemic, mobile health (mHealth) presents new opportunities for youth mental health research, practice, and policy.

Methods. This multi-methods research project includes a scoping review that assesses the current landscape of mHealth intervention in the field of youth mental health. To understand mHealth usage in the real world, I used a quantitative approach to analyze service access and utilization data across three delivery modality groups at a local integrated youth services (IYS) setting over a 4-year period (2020–2023). This quantitative analysis informed two qualitative studies guided by both inductive and deductive approaches. We investigated the perspectives of stakeholders on mHealth integration and meaningful youth engagement in its design. Data were gathered through semi-structured interviews. Results from all studies informed recommendations for mHealth practices and policies.

Results. The scoping review revealed rapid growth in mHealth interventions but highlighted significant gaps in youth-centred design, equity, and engagement.

Quantitative findings demonstrated patterns of service utilization across three modalities, with hybrid models showing potential for increased accessibility. Qualitative analyses identified critical facilitators and barriers to mHealth integration. Youth engagement emerged as a pivotal factor for sustainable mHealth development, the key to its implementation was identified using the consolidated framework of implementation research. In my summary chapter, I synthesize the findings from all studies and propose next steps for research, practice, and policy.

Significance. For youth navigating mental health challenges and technology reforms, mHealth spaces can be exciting but have potential risks. There is an imminent need to understand how to engage youth to design safe and effective tools to deliver high quality care. The goal of this work is to generate new knowledge that provides evidence to support youth mHealth best practices, standards, and health policies in Canada and beyond.

Lay Summary

This manuscript-style thesis is composed of four research papers. This dissertation explores how mHealth can support youth mental health by examining existing interventions, analyzing service utilization patterns, and identifying barriers and facilitators to integrating mHealth into youth-centred services. The findings highlight gaps in youth-centred design, equity, and engagement within mHealth interventions. Engaging with mHealth partners highlights the critical importance of meaningful youth involvement in the design and implementation of mHealth solutions. By recognizing these gaps, this work provides evidence to inform best practices, standards, and policies for delivering high-quality, youth-centred mental health care in Canada and beyond.

Preface

This thesis is my (Xiaoxu Ding) original intellectual product. This thesis was developed and supervised by Dr. Skye Barbic, Dr. Liisa Holsti, Dr. Brodie Sakakibara, Dr. Julia Schmidt, and Dr. Natalie Parde. The scoping review (Study 1) mapped the existing literature on the topic of mobile health (mHealth) in youth mental health to identify key concepts, gaps, and evidence to inform future research and practice in the field. The study was published in May 2023. The quantitative study (Study 2) used an existing cohort data set to analyze the service utilization patterns across three service access modalities (UBC Ethics #H23-03606). The first qualitative study (Study 3) used semi-structured interviews with mHealth stakeholders to understand the facilitators and barriers to mHealth integration in an integrated youth service (IYS) setting; the second qualitative study (Study 4) investigated factors influencing meaningful youth engagement implementation in mHealth services by analyzing the same set of interview data (UBC Ethics #H22-03454). Results for these studies have been presented at multiple international conferences including the International Society of Quality of Life, International Association for Youth Mental Health, and the International Conference for Integrated Care. Studies 1 is published and studies 2, 3, and 4 are currently submitted for peer-reviewed publication. Generative AI was not used for any aspects of the work.

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List of Abbreviations

BC	British Columbia
COVID-19	Coronavirus disease 2019
COREQ	COnsolidated criteria for REporting Qualitative research
CFIR	Consolidated Framework for Implementation Research
GBD	Global Burden of Disease
IYS	Integrated Youth Services
LHS	Learning Health System
MEDLINE	Medical Literature Analysis and Retrieval System Online
MeSH	Medical Subject Headings
mHealth	Mobile Health
MHSU	Mental Health and Substance Use
PCORI	Patient-Centered Outcomes Research Institute
PE	Perceived Ease of Use
PU	Perceived Usefulness
RCT	Randomized Controlled Trial
RQ	Research Questions
SPOR	Strategy For Patient-Oriented Research
TAM	Technology Acceptance Model
UBC	University Of British Columbia
UCD	User-Centred Design
VR	Virtual Reality

WHO	World Health Organization
YLD	Years With Lived Disability

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Land Acknowledgement

I would like to acknowledge that this dissertation was completed on the traditional, ancestral, and unceded territory of the Coast Salish Peoples, including the territories of the x^wməθk^wəyəm (Musqueam), Sk̓w̓x̓wú7mesh (Squamish), and səlilwətəl (Tseil- Waututh) Nations. I recognize and honour their enduring connection to this land, as well as their ongoing contributions to the communities. I express my gratitude for the opportunity to conduct my work here and commit to supporting Indigenous voices and perspectives throughout my research, both in this dissertation work and beyond.

Dedication

To my friends and family.

“We want to wrap technology around our problem, not the problem around technology.”

Study participant.

Chapter 1: Introduction

1.1 Introduction to the Problem

Mental health conditions are now responsible for 1 in 6 years lived with disability (YLD).¹ Globally, one in seven 10–19-year-olds experiences a mental disorder, representing 13% of the global burden of disease (GBD) in this age group.² In Canada, mental health issues affect one in four youth aged 12–24 years, the highest incidence of mental disorders of any age group.^{3,4} However, a significant gap remains between the number of youth who need mental health care and those who have access to it.¹ For those who are racialized, marginalized, or living in nonurban settings, the barriers to accessing care are even more pronounced.⁵ As such, there is an urgent need to reexamine how current health care services can meet youths' needs to optimize equitable access to care for all.⁶

1.2 Background

Mental health challenges pre-date multiple current global crises. Prior to the COVID-19 pandemic, 1.2 million children and youth were impacted by mental health issues. By the age of 25, this number increases to 7.5 million, which represents roughly one in five Canadians.⁷ Climate change,⁸ social connectedness,⁹ the drug toxicity epidemic,¹⁰ and the COVID-19 pandemic have presented more challenges to a health

system and population already experiencing duress.¹¹ Public health measures related to COVID-19 not only worsened existing mental health conditions but also increased the risk of developing new ones in vulnerable populations.¹² Addressing the mental health needs of youth is a priority for many places across the world, including Canada, and British Columbia (BC) specifically. Reimagining equitable health care access for all youth is critical. This includes determining how youth improve their mental health literacy, access services, and contribute to the codesign of community programs, including virtual programs, that meet their needs.^{13,14} Recently, particularly during the pandemic, mobile health (mHealth) has shown potential to revolutionize the traditional health care system and offers a promising solution to address the unmet mental health needs of youth.¹² This dissertation describes mHealth in detail and discusses how it can support youth mental health.

1.3 Context for My Dissertation Project: Integrated Youth Services in BC

Well before the COVID-19 pandemic, transformative change and service redesign for youth was viewed as necessary in BC.⁶ In September 2014, a team submitted a proposal titled *Transforming Access to Health and Social Services for Transition-Aged Youth (12–25)* to the Select Standing Committee on Children and Youth in British Columbia calling for “the creation of a network of health and social service centres across BC that would provide youth- and family-centred services to youth with mental health

disorders.”⁶ This proposal led to the establishment of Foundry, an integrated youth services (IYS) initiative. Foundry delivers free, accessible IYS for youth across BC, including a virtual care service delivered via a mobile service platform, the Foundry BC app (as discussed later in this section). At the time of this dissertation submission, there are also 17 physical Foundry centres in operation and 18 more in development. Foundry aims to meet youth where they are at, considering all developmental, social, technological, and health needs a young person may have.¹⁴

A core ingredient of the IYS model is for youth to access care in one “single access point” or “one-stop-shop.”¹⁵ IYS aims to prevent youth from having to repeat their stories across different health institutions and service providers. IYS also provides access to a variety of service providers, such as physicians, nurses, counsellors, and peer support workers, to co-design the care experience that youth need to improve their outcomes. Foundry covers multiple service areas for youth, including physical and sexual health, mental health, substance use support, social services (housing, education, and employment support), and peer support. Currently, the IYS model is emerging as a potential pan-Canadian investment to support youth mental health and substance use challenges and outcomes.¹⁶ This system presents a unique opportunity not only for youth, but also for researchers and policymakers to learn about the benefits of jurisdictions working together with a common vision and mission.

Early learning from Foundry and other IYS providers highlighted that not all youth prefer in-person care in a physical location, particularly during and after the lockdowns. Several investments are being made to work with diverse youth across BC to co-design new versions of the technology that can support centre navigation or virtual-care navigation. Along with the rising use of mHealth, this presents an ideal time to work with youth to understand their remote health care access needs and to study a natural cohort of youth accessing and using the Foundry BC app to navigate the health system in BC.

1.4 Research Questions (RQs)

The overarching goal of this thesis is to contribute empirical evidence for mHealth development, implementation, and regulation for IYS in Canada and beyond.

Study 1: Scoping Review

RQ1: What is known in the existing literature about the feasibility and effectiveness of mHealth intervention for youth aged 12–24 years facing mental health challenges?

Study 2: Quantitative Study

RQ2a: What are the differences in the demographic and clinical characteristics among youth who accessed service from three different modalities: virtual, in-person, and hybrid?

RQ2b: What is the overall service utilization patterns across three groups (virtual, in-person, hybrid)?

Study 3: Qualitative Study (Inductive)

RQ 3a: What are the perceptions of mHealth among users, service providers, and nonclinical staff regarding its effectiveness and impact on youth mental health services?

RQ 3b: What are the perceived barriers and facilitators amongst IYS stakeholders to mHealth integration within the larger Foundry IYS network?

RQ 3c: What strategies do stakeholders identify as essential for the sustainability of mHealth services for youth in British Columbia?

Study 4: Qualitative Study (Deductive)

RQ 4a: What are the factors influencing youth engagement within an IYS setting to support mHealth technology and service development?

RQ 4b: What actions are needed to ensure meaningful youth engagement in mHealth development and sustainment planning over time?

1.5 Organization of This Dissertation

Seven chapters are included in this multi-methods dissertation, including four manuscript-style chapters. The methods are included within each manuscript.

The first chapter is a preliminary background, along with my research problem and objectives. The second chapter is a background literature review on the general

concepts and frameworks used in this dissertation. Chapter 3 is my first manuscript ¹⁷ (published) that synthesizes existing literature to identify the current breadth and depth of mHealth intervention in youth mental health settings. Chapter 4 is the second manuscript (under peer review) describing the demographic and service utilization difference among three groups of youth who registered with a provincial youth mental health service. Chapter 5 is the third manuscript (under peer review), a qualitative study outlining the facilitators and barriers influencing mHealth integration in an IYS setting. Chapter 6 is the fourth manuscript (in preparation for peer review) that identifies key factors contributing to meaningful engagement in mHealth service design and implementation. Chapter 7 is the final conclusion chapter that summarizes and reiterates research results from all four studies and elaborates on implications, contributions, strengths and limitations, and future research, practice, and policy orientation. Because this thesis is written in manuscript style, some repetition is necessary to help transition between sections and reinforce key concepts. Although excessive repetition has been avoided, certain ideas are revisited in different sections to support the overall structure of the manuscripts and dissertation.

1.6 Summary

As a PhD student pursuing a degree in Rehabilitation Science, I follow the definition of *recovery* as “a way of living a satisfying, hopeful, and contributing life even

with limitations caused by illness.”¹⁸ I aim to provide evidence on how to use mHealth interventions to provide quality health care services to youth and potentially inform health policymaking. Transitional age youth, defined here as from adolescence to early adulthood (aged 12–24), are in a critical period of life development characterized by social, environmental, physical and cognitive changes.¹⁹ During this time, youth experience changes in their social roles and function, family and peer support, and health care delivery (i.e., from pediatric to adult settings).¹⁹ Therefore, the general goal of my research is to help youth go through this period with more ease.

Foundry, the IYS partner organization that supported many aspects of my research, has a youth research engagement program that invites youth to provide feedback throughout research studies. I leveraged this partnership throughout my studies to guide the thesis in a good way. My goals as a mHealth researcher are to (a) navigate existing obstacles to create an optimal environment for both youth and health care stakeholders; (b) keep an open mind and avoid complicating health care access by burdening youth with unnecessary technology; and (c) continuously assess and adapt the best technologies and interventions, transforming potential mHealth barriers into facilitators. As well, by being embedded at the Foundry Central Office as a trainee, I was able to integrate my results quickly into practice to make meaningful change. I hope to continue future research to engage youth in future mHealth innovation and scientific

exploration to creating better health outcomes and experiences for all youth who need support.

Chapter 2: Literature Review

2.1 Youth Mental Health

Mental illness is the leading cause of disability worldwide and is considered a global public health challenge.^{20,21} One in four people around the world are affected by mental health disorders each year, with up to 50% of all people experiencing mental health challenges in their lifetime.²² The global burden of disease (GBD) is exacerbated by the mental health treatment gap,²¹ which refers to the disparity between the proportion of people who receive treatment and those who do not. A World Health Organization (WHO) report stated that the untreated rate for schizophrenia was more than 30% and the percentage went up to over 50% for depression and anxiety, indicating many people with mental health challenges across the globe experience significant barriers to accessing specialized care.²³

Mental illness impacts approximately 1.2 million children and youth. By the age of 25, this number increases to 7.5 million, representing about one in five Canadians.²⁴ Before the age of 25, 75% of people with mental health disorders have onset at ages 12–24 years.²⁵ This is a peak period of development for youth, often a stage of life to pursue education or career milestones, build social relationships, and explore new interests. Although youth are often perceived as healthier and more energetic compared to older adults, many youth encounter obstacles while accessing health care services for mental

health challenges.²⁶ Such barriers may include lower family socioeconomic status, cost, the inability to access care on their own due to their age, lack of confidentiality, managing school or employment and attending specialist appointments, and transportation.^{27,28} Equity-deserving youth, such as those who identify as gender nonbinary or have unstable housing situations, face even greater challenges when accessing health care services.²⁹⁻³¹ At the same time, youth health services have been critiqued for not being youth-centred, culturally sensitive, or trauma-informed.¹³

Youth are at increased risk of mortality and comorbidities because, if their physiological and psychological health care needs go unmet during this critical developmental period, the effects often extend across their lifespan.^{32,33} Decades of studies support the need for a full range of traditional and innovative interventions to support youth,³⁴ including health promotion,^{35,36} early intervention,^{37,38} and long-term supports including self-management,³⁹ community-based outreach program,⁴⁰ and hospital care.⁴¹ Yet, limited evidence supports a coordinated system of care that meets youth where they are at and ensures access to evidence based treatment where and when they need it. In response, mobile health (mHealth), a term used to describe a collective set of digital mental health interventions implemented via mobile devices, has been proposed as a solution to meet the needs of youth across the world.

2.2 Mobile Health

By 2024, the number of mobile phone users globally approached 5 billion, representing approximately 60% of the world's population.⁴² In many developed countries, such as Canada and the United States, 97% of people own a mobile phone and 85% of the entire population is using a smart phone.^{43,44} Such mass usage is motivating the rapid growth of medical software and applications for diverse populations, including youth.⁴⁵ These mobile device-based apps cover multiple domains of technologies used to assess, capture, and support areas of health including physical activity and fitness, diet, emotional and mental health, and health services. Currently, mHealth services are being implemented in different forms with different purposes. For example, for sexual health, services push text message reminders, use educational apps to increase knowledge about sexually transmitted diseases, improve contraceptive use, and enhance access to sexual health services among youth.^{35,46} There is also growing interest in using mHealth interventions to promote general health behaviours, such as physical activity, healthy eating habits, and sleep quality.⁴⁷

With the rapid development of fast cellular networks, smart device technologies have created more options for the delivery of health care services through mHealth technologies.⁴⁸ As of 2024, there were over 36,000 health care and medical apps available on the Google Play store. The number peaked in the last quarter of 2021 at

65,000.⁴⁹ Similarly, the iOS platform reached its highest count of 54,000 health apps during the same year.⁵⁰ In the adult space, mHealth has been widely recognized as a convenient and economical way to access health care.⁵¹ With most youth connected to the internet in high income countries,⁵² mHealth creates a new way for youth to access information and care where and when they need it.

The COVID-19 pandemic notably created a substantial opportunity for health care to utilize technology in delivering services to a wide range of populations. Public health measures encouraged many to adapt to different ways of delivering or receiving care, including mental health.¹² Diverse types of mHealth tools have been implemented across settings to support the self-assessment and screening of mental health conditions. These tools also deliver mental health interventions, such as mindfulness, cognitive behavioural therapy, self-monitoring, self-management, and psychoeducation or health literacy.⁵³⁻⁵⁶

As the pace of mHealth technologies grows exponentially, the same cannot be said for regulation and standards of the apps themselves. Different studies define youth, adolescents, and young people differently and the age ranges vary. Studies addressing this age group covers participants as young as 5- or 6-years old⁵⁷ to over 30 years old.⁵⁸ Most mHealth studies are being conducted in developed countries, leaving a huge gap for health care service access in lower-resourced areas globally. In a recent study of nearly 300 apps for mental health, fewer than one third of apps received input from a mental

health expert.⁵⁹ Governments around the world have been criticized for not keeping up with the industry, putting pressure on the service user to make their own decisions about safety, efficacy, and impact.¹ There is limited expert input on mHealth, and clear standards for these tools are still lacking. Additionally, little is known about the effectiveness of mHealth interventions, especially for diverse populations like youth experiencing mental health challenges. For youth, there are concerns that many available technologies have safety, validity, sustainability, and implementation issues.⁶⁰ There have also been concerns about the lack of standards to guide developers to ensure a safe space is provided for youth who access the technologies for health.⁶¹ Finally, and perhaps most importantly, the inclusion of diverse youth in the co-design and early implementation of these technologies has been limited.⁶²

In summary, the field of mHealth often presents a dichotomy of opportunity and risk. On one hand, the lack of standards and national regulation in the field of mHealth apps presents global concern for the safety of youth, notably personal security and the uptake of misinformation.^{63–65} On the other hand, mHealth may have an increasingly important role in health promotion, education, and interventions to bridge the gap for those who cannot access in-person care.⁶⁶ The preference for mHealth over in-person services among youth is influenced by various factors, including convenience, privacy, accessibility, and familiarity with technology. Some young people find mHealth

interventions more appealing due to their flexibility, ease of use, and the ability to receive support or information anonymously.

A crucial part of my dissertation is to understand how youth perceive the use and design engagement of mHealth products. Meanwhile, this work helps to explore the potential that not all youth prefer mHealth interventions exclusively – some value face-to-face interactions, especially when dealing with sensitive health issues or when in-person care is necessary. Moreover, it is essential to consider potential reactions in the household to bringing health care into the home. Using mHealth to access care at home could have negative impacts, such as increased caregiver burden, emotional and psychosocial influences at home, privacy concerns, or reformation of social relationships.⁶⁷ A greater understanding of the ways in which youth use mHealth technologies in their daily lives is needed, with a particular focus on how they navigate safety risks and utilize these tools to enhance health and wellness outcomes.

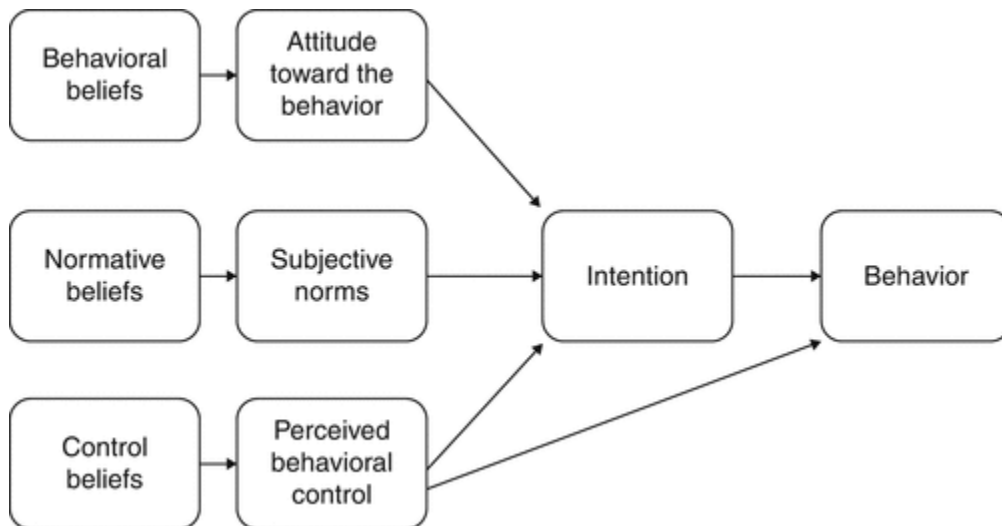
2.3 Technology Acceptance Model

The technology acceptance model (TAM) is an information systems theory that models how users come to accept and use a technology.⁶⁸ For this dissertation work, it was used as a guiding framework when designing studies, drafting research questions, and designing interview guides to understand the key factors influencing mHealth integration for different groups of mHealth stakeholders supporting youth.

TAM has evolved through four versions in the literature. The theory of reason action proposed by Fishbein & Ajzen (1975), was developed prior to TAM, but is generally considered to be the first stage of the TAM evolution to predict and explain human behaviours (see Figure 1).⁶⁹ This theory introduced the concept of the *subjective norm* as a factor of behavioural intention, which is defined as a “perception that most people think he should or should not perform the behavior.”⁶⁹ Individuals multiply the normative belief strength by motivation and sum up the entire resulting weights to decide on behavioural intention.

Figure 1

Theory of Reasoned Action

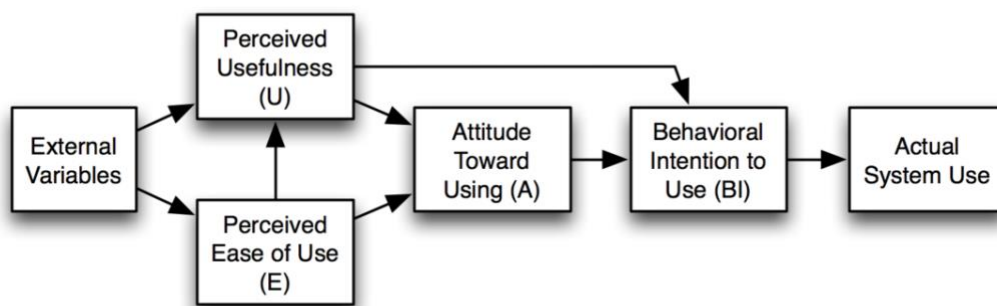


Note. Adapted from Fishbein and Ajzen.⁶⁷

Fred Davis introduced TAM in 1989 to describe the acceptance and use of technology.⁶⁸ The model focused on two individual beliefs: perceived usefulness (PU) and perceived ease of use (PE, see Figure 2). Davis stated that these two beliefs were the key factors influencing attitudes, which in turn shaped the intention to use information technology. The TAM model is widely discussed in scientific literature, with more than 4 million relevant results shown in Google Scholar in October 2024. Although newer versions, including TAM2 and TAM3 along with various adaptations (which are briefly introduced in the next paragraph) have been developed, their core structure and fundamental assumptions remain consistent with the original TAM.

Figure 2

Technology Acceptance Model

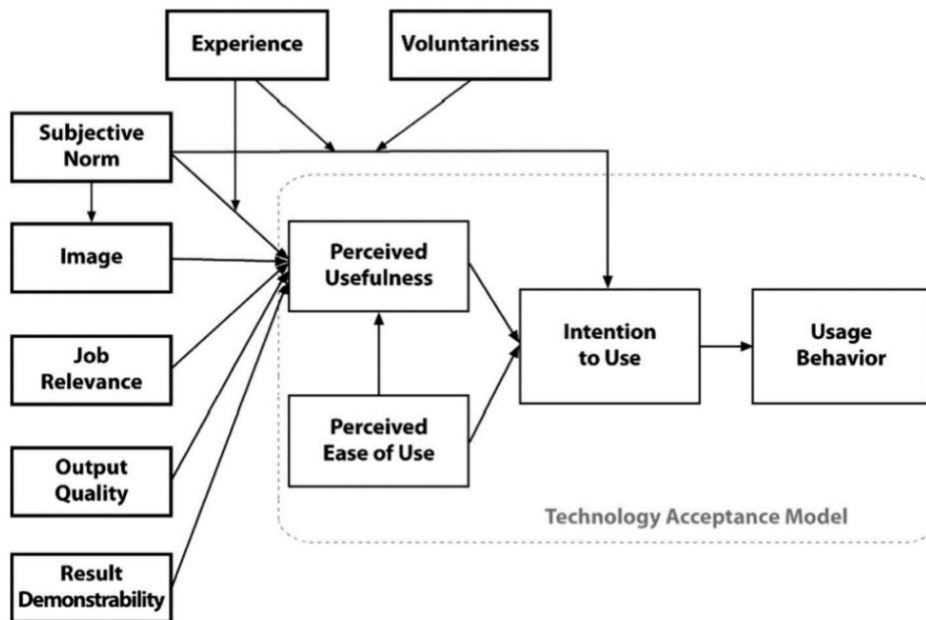


Note. Adapted from (Davis, 1989).⁶⁸

Venkatesh and Davis (2000) developed TAM2 by adding social influences (subjective norm, voluntariness, image) and cognitive instrumental processes (job relevance, output quality, result demonstrability),⁷⁰ seeking to identify the variables that influence PU (see Figure 3).

Figure 3

Technology Acceptance Model-2



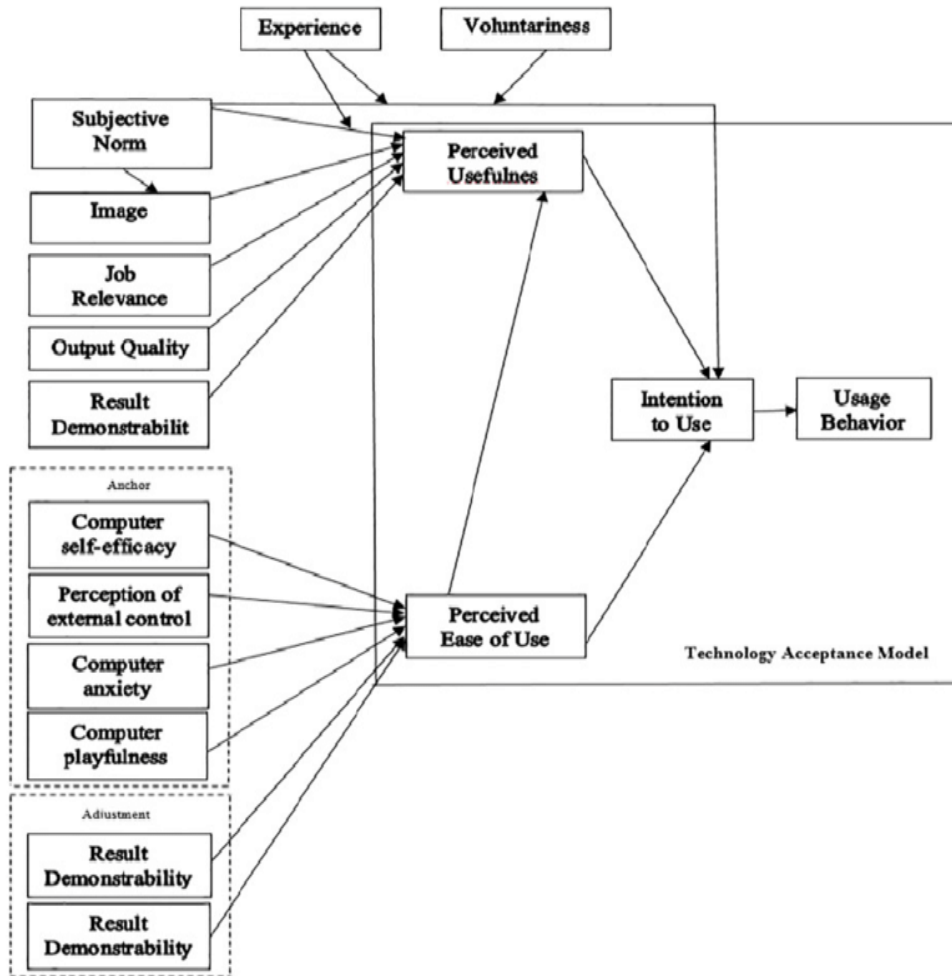
Note. Adapted from Venkatesh and Davis (2000).⁷⁰

Venkatesh and Bala (2008) updated TAM from TAM2 to TAM3, the latest iteration. This update focused on expanding the number of determinants that affect the

PU and PE producing a positive behavioural intention, followed by use behaviour in an e-commerce context (Figure 4).⁷¹ In TAM3, PE is influenced by additional anchor variables (computer self-efficacy, perceptions of external control, computer anxiety, computer playfulness) and adjustment variables (perceived enjoyment, objective usability). Experience and voluntariness act as modifiers of behavioural intention.

Figure 4

Technology Acceptance Model (TAM)-3: TAM Adapted for the e-Commerce Environment



Note. Adapted from Venkatesh and Bala (2008).⁷¹

Overall, TAM offers a crucial lens for examining the adoption of mHealth solutions in youth mental health. It can help identify factors shaping stakeholders' acceptance of mHealth tools and support qualitative data analysis of how those perceptions influence the integration of mHealth into existing youth mental health services.

2.4 User-Centred Design

The design of technological products is not always perfect or intuitive. Flawed design exists in all walks of life, but, with respect to mHealth, even more attention must be paid to a user-friendly experience because mHealth tools can impact health conditions. It is essential that youth are included in the co-design of the products for which they will be the end users. In this section, the importance of user-centred design (UCD) is discussed with respect to providing better user experiences for youth who are seeking support for mental health challenges. UCD was also used as a guiding tool for qualitative research interview questions in manuscripts 3 and 4.

UCD is a broad term used to describe design processes in which users, or the people who use the product, influence decisions about the design of the product and intended application for the priority audience.⁷² UCD is largely rooted in human-computer interaction, industrial design, and cognitive psychology. A wide spectrum of UCD concepts have been outlined for decades,⁷² but the key concept of relevance here is involving end users throughout the design process.⁷³ This concept further informs the youth engagement and mHealth development interaction in my dissertation.

In 2017, Still and Crane described 10 simple and fundamental UCD principles to follow in mHealth design⁷⁴ (a) involve users early, (b) involve users often, (c) design for use in text, (d) keep it simple, (e) be polite, (f) know your users, (g) give users control,

(h) remember and design for emotion, (i) trust but verify, and (j) discover before designing and delivering. Developers must know that discovery never ends, even after delivery. Other research has emphasized four factors that are critical to UCD and the implementation of a product into evidence-based practice and policy.⁷² I discuss these four factors next and how they can be applied to youth mHealth design and service delivery.

2.4.1 Identification of End Users and Their Needs (Factor 1)

The first factor in UCD is clear identification of end users and their needs. Even with an identified mental health concern, such as an eating disorder or anxiety disorder, mHealth tools have multiple objectives, including assessment, prevention, intervention, education, and others.⁷⁵ Explicitly identifying the primary, secondary, or even tertiary goal of a product should be the priority for all mHealth developers to ensure that the product effectively meets user needs and enhances product quality.^{76,77} This goal identification is especially true for tools for youth with lived and living experience of mental health challenges, because they are more likely to experience negative mental health outcomes.⁷⁷ Therefore, understanding their needs and including them in product design is a crucial concept for development, and youth engagement is a core concept throughout this thesis.

2.4.2 Prototyping and Rapid Iteration (Factor 2)

The second factor in UCD is prototyping and rapid iteration, which can best be represented by the mantra “fail early and often.” It is the technical process of making ideas tangible in order to quickly test and make improvements based on feedback, allowing a preliminary, low-fidelity product to be rapidly transformed into the ultimate product.^{73,78} For mHealth development for youth, prototyping and rapid iteration is essential, for many reasons – notably because youth needs evolve quickly as the technology and society change. An appropriate transition from youth mental health services to adult care is rarely achieved.⁷⁹ Product development requires consistent involvement of youth not only in the co-design and prototyping, but also during the ongoing evaluation of impact.

The earlier COVID-19 pandemic exposed significant gaps in health service to keep pace with the evolving needs of youth.⁸⁰ Without youth involvement in traditional spaces of intervention development, youth found social media platforms to connect and support each other. Key mHealth research priorities were outlined including exploring safe spaces for youth, addressing the promotion of harmful products, examining the portrayal of medical advice and illness, tackling the spread of misinformation and disinformation, combating the dissemination of sensitive or hateful content, and investigating problematic usage or addiction.⁶⁶

New concerns emerged during the iteration process, highlighting the urgent need for public health leaders to address the potential health risks of platforms used by youth to access mental health information. It is crucial for researchers to work with stakeholders and policymakers to develop and regulate appropriate guidelines for mHealth services for both adults and youth. This collaboration would help minimize the time spent translating results from clinical research to real-world practice, improving the implementation speed of innovative technology (e.g., virtual reality, augmented reality, wearable devices, gaming). For my thesis, I considered this factor throughout, to ensure the development of integrated knowledge translations strategies that meaningfully support decision-making at Foundry.

2.4.3 Simplification (Factor 3)

The third concept of UCD is to simplify existing intervention parameters and procedures. As one of the key overarching principles to increase learnability and decrease cognitive load required for users to interact with the product, simplification has long been a hallmark of UCD.⁸¹ For example, unnecessary data collection forms and excessive navigation steps originally designed for other user groups (e.g., mHealth targeting older adults may add repetitive instructions steps for using electronic devices) can be removed to improve application and usability for young users.^{73,82} For the last 2 decades, extensive literature has consistently called for providing routine data-driven feedback from users

and health service providers to reduce premature dropouts and improve intervention outcomes in research.⁸³ Simplification is a key concept of ensuring rapid, meaningful collection of data from youth to inform care. As well, to guide the direction of my thesis, at a systems level research data should collectively tell a story of the impact of an intervention or service, providing real-time feedback to inform future service design and quality improvement efforts.⁸³ For mHealth to become a core component of service delivery for youth, its simplicity, conciseness, and effective optimization within the context of youth mental health services provide a basis for this dissertation to recommend strategies for seamless integration.

2.4.4 Exploiting Natural Constraints (Factor 4)

The last design concept of UCD is exploiting natural constraints. This concept is less related to the product itself, but rather to external environmental influences including budget, organizational limitations, and timeline to complete the product.⁸⁴ These types of constraints are unavoidable and mostly out of developers' control. However, they are critical for the sustainability of mHealth interventions in health care. Early planning and engagement of additional end users, such as funders and government representatives, are considered key parts of UCD to ensure sustainability.

In brief, there are four main components (factors) that are critical to user-centred design when building mHealth interventions or services for youth. Although these areas

of discussion are relevant to mHealth development and evaluation, they also have significant potential to guide research in this area. For my doctoral work, perception of mHealth services (identification of end-users needs), co-design with youth during the design and development phase (rapid prototyping), user-centred design (simplification), facilitator and barriers of mHealth implementation and integration to existing systems (natural constraints) were key throughout the design of my interview questions, methods, interpretation of findings, and plans to mobilize results into practice and policy.

2.5 Youth Engagement

Closely tied with a youth-centred design, youth engagement refers to involving youth in the planning, design, and delivery of health care services which affect their lives, livelihoods, and futures.⁸⁵ It involves empowering youth to be active participants in their health care decision-making and creating opportunities for their input and feedback to be incorporated into the delivery of health care services. As my dissertation took shape, I found that effective methods for facilitating meaningful youth engagement were lacking, and this concept was rarely brought up in existing mHealth research as a part of the intervention plan.^{17,86} As a result, I added an additional study to understand the feasibility, barriers, and facilitators of incorporating youth engagement to improve youth health outcomes and mHealth sustainability in an IYS context (Study 4). In the next section, I introduce one fundamental difficulty preventing youth from accessing and

engagement in mHealth and three perspectives on how to approach youth engagement from school collaboration, co-design, and sustainability considerations.

2.5.1 Access Difficulties

According to the United Nations Children's Fund report estimating digital connectivity during the COVID-19 pandemic, two thirds of children and youth aged 25 years or less across the globe (2.2 billion) do not have an internet connection or hardware (e.g., smartphone, computer, tablet) at home.⁵¹ Connectivity and access to affordable fast internet services is a privilege that cannot be overlooked in terms of equity across developed and developing countries. For example, 90% of youth in high-income countries have access, whereas in some low-income countries, such as those in west and central Africa, the proportion is estimated to be 3–6%.⁵² Although my dissertation mainly focuses on youth in BC, I aim to use my work to inform diverse settings and types of youth, including those from low-, medium-, and high-income settings.

2.5.2 Patient Engagement Models

As seen in the discussion on UCD, it is essential to engage end users – in this case, youth – in the mHealth development and implementation stages. Several models of patient engagement exist for research. In Canada, the Strategy for Patient-Oriented Research (SPOR) outlined patient engagement in governance and decision-making and capacity building.⁸⁷ In the United States, the Patient-Centered Outcomes Research

Institute (PCORI) outlined reciprocal relationships, partnerships, co-learning, and transparency, honesty, trust as the core engagement principles to improve clinical decision-making and outcomes.⁸⁸ For youth, models like the McCain Model for youth and family engagement exist to inform levels of engagement in research, including forming partnerships, ongoing consultation and projects, short-term commitments, and sharing knowledge.⁸⁹ The following sections introduce several perspectives on youth engagement applicable to mHealth implementation.

i. School Collaboration. One of the major obstacles to youth accessing health care services is the schedule conflict between school-aged youth and service providers.⁹⁰ To address this barrier, many mHealth tools were developed to address health concerns in a school setting including smoking intervention,⁹¹ reproductive psychoeducation,⁹² and unhealthy eating intervention and weight management.⁹³⁻⁹⁵

In a real-world school setting, there are many factors to consider when school staff and health care providers aim to establish a multilevel communication system to keep all parties engaged.⁹⁶ The primary goal of implementing mHealth in a school setting is to enhance interaction between youth and health care providers. This includes ensuring that all youth receive comprehensive information, access confidential, personalized health services, and fully engage with the mHealth tool. For effective engagement, the PCORI Engagement Rubric, which promotes collaboration with patients, caregivers, and

other health care stakeholders in research, offers valuable guidance.⁸⁸ Applying this rubric is essential when involving youth in mHealth development and implementation. Additionally, youth engagement in a school setting may require adapting these engagement principles to fit the unique context. A successful PCORI-guided mHealth development and implementation project with youth engagement at school-based health centres incorporates the following key strategies:⁹⁶

1. Engagement of key stakeholders in app development;
2. Engagement of key stakeholders in implementation effort;
3. Partnership, compensation, and reciprocity;
4. Co-learning to support integration into clinical workflows;
5. Ongoing quality improvement;
6. Transparency, honesty, and trust; and
7. Celebrating success and expressing appreciation.

Current studies demonstrate the feasibility of implementing clinical services to school students using mHealth.^{96,97} However, it is still challenging for schools to collaborate with mHealth service without the support of an existing clinical research team in real-world settings.

ii. Youth Engagement in Co-Design. Research has shown that youth involvement can guide both mHealth content and the aesthetic design of the interface to

increase the likelihood that they will appeal to their peers.⁹⁸ Engaging youth can provide insights into the reading and comprehension level of the content used in the mHealth tool to ensure it is developed in a way that is meaningful to both youth and clinicians.⁹⁶ However, improving the aesthetic design and the readability of mHealth tools is only the first step for youth engagement.

The co-learning process presents an interconnected cycle of knowledge, practice, and data to address emerging health challenges. The process to solve a problem of interest starts from the intention to study and continues through steps to collect data, assemble data, analyze data, interpret results, represent knowledge, manage knowledge, apply knowledge, and eventually take action to change practice.⁹⁹ To develop a mHealth intervention that addresses my problem of interest, current literature advises mHealth developers to involve youth at every stage of the process to (a) identify principles and standards, (b) define the appropriate data capture strategy that is acceptable and feasible for youth, (c) co-design the product side-by-side with youth, (d) exchange feedback and insights for quality improvement, and (e) translate knowledge to network and practice improvement.^{96,99–101} Implementing a successful youth engagement program ensures that the final product is meaningful and valuable to both youth and service providers, while also promoting better health practices and policies for youth. However, at this time, this

engagement is rarely done. This thesis aims to explore these barriers and provide solutions for meaningful engagement in co-design processes.

iii. Youth Engagement in Sustainability Planning. Even though strategies to increase engagement in mHealth have been studied, there is no consensus on the key ingredients to support maximal engagement of youth.⁹⁸ Researchers conceptualized the term “engagement” with different foci. Some emphasized human-computer interactions, communication, marketing, and game-based learning,¹⁰² while others focused on user experience quality, challenges of feedback, novelty, interactivity, perception, and awareness of technology design.¹⁰³ To develop regulations and potential ethics guidelines for youth engagement in mHealth design, it is crucial to capture the metrics within the complex relationship between online youth mHealth engagement and offline behavioural change. To achieve this goal, it is helpful to define effective engagement as sufficient engagement with the mHealth intervention throughout the design and implementation phase of mHealth tool in order to achieve the intended outcomes, instead of simply adding “more engagement” to the process.¹⁰⁴

In summary, to propose and validate regulations and future universal ethical guidelines of effective youth engagement, mHealth researchers need to conceptualize youth engagement more comprehensively and dynamically. This engagement is explored

in Study 4, and knowledge gained can be used to inform the implementation of mHealth within the pan-Canadian IYS network.

Chapter 3: Study 1 Scoping Review

Understanding Mobile Health and Youth Mental Health: Scoping Review

This manuscript has been published and it is referenced here:

Ding X, Wuerth K, Sakakibara B, et al. Understanding Mobile Health and Youth Mental Health: Scoping Review. *JMIR Mhealth Uhealth*. 2023;11:e44951.
doi:10.2196/44951

Summary

Background: The 75% of the population with mental health disorders have an onset of illness between the ages of 12 and 24 years. Many in this age group report substantial obstacles to receiving quality youth-centred mental health care services. With the rapid development of technology and the recent COVID-19 pandemic, mobile health (mHealth) has presented new opportunities for youth mental health research, practice, and policy.

Objective: The research objectives were to (a) synthesize the current evidence supporting mHealth interventions for youths who experience mental health challenges and (b) identify current gaps in the mHealth field related to youth's access to mental health services and health outcomes.

Methods: Guided by the methods of Arksey and O'Malley, we conducted a scoping review of peer-reviewed studies that used mHealth tools to improve youth mental health

(January 2016–February 2022). We searched MEDLINE, PubMed, PsycINFO, and Embase databases using the following key terms: “mHealth,” “youth and young adults,” and “mental health.” The current gaps were analyzed using content analysis.

Results: The search produced 4270 records, of which 151 met inclusion criteria. Included articles highlight the comprehensive aspects of youth mHealth intervention resource allocation for targeted conditions, mHealth delivery methods, measurement tools, evaluation of mHealth intervention, and youth engagement. The median age for participants in all studies is 17 (IQR 14-21) years. Only 3 (2%) studies involved participants who reported their sex or gender outside of the binary option. Many studies (68/151, 45%) were published after the onset of the COVID-19 outbreak. Study types and designs varied, with 60 (40%) identified as randomized controlled trials. Notably, 143 out of 151 (95%) studies came from developed countries, suggesting an evidence shortfall on the feasibility of implementing mHealth services in lower-resourced settings.

Additionally, the results highlight concerns related to inadequate resources devoted to self-harm and substance uses, weak study design, expert engagement, and the variety of outcome measures selected to capture impact or changes over time. There is also a lack of standardized regulations and guidelines for researching mHealth technologies for youths and for the use of non–youth-centred approaches to implementing results.

Conclusion: This study may be used to inform future work as well as the development of

youth-centred mHealth tools that can be implemented and sustained over time for diverse types of youths. Implementation science research that prioritizes youths' engagement is needed to advance the current understanding of mHealth implementation. Moreover, core outcome sets may support a youth-centred measurement strategy to capture outcomes in a systematic way that prioritizes equity, diversity, inclusion, and robust measurement science. Finally, this study suggests that future practice and policy research are needed to ensure the risk of mHealth is minimized and that this innovative health care service is meeting the emerging needs of youths over time.

3.1 Introduction

Mental Illness

Mental health disorders are the leading cause of disability worldwide and are considered a global public health challenge.^{20,21} Globally, 1 in 4 people are affected by mental health disorders each year; up to 50% of people experience mental health challenges in their lifetime.²² The global burden of disease (GBD) is compounded by the “mental health treatment gap,” referring to those people in need of mental health treatment but who have not received it. People with mental health challenges experience different levels of barriers to accessing specialized care when needed.²³ Such barriers are multifaceted and may include poor mental health literacy, social stigma, trust and

confidentiality issues with health professionals, and systemic difficulties such as financial hardship.²⁶

A total of 75% of people with mental health disorders have an onset of illness between the ages of 12 and 24 years.²⁵ This is a peak period of development for youths (defined here as ages 12–24 years); it is often the life stage to pursue education or begin a career, to build social relationships, and to explore new interests.¹⁰⁵ Yet, youths experience the worst levels of access to mental health care from poorly designed, grossly under-resourced, and typically unfriendly health care services.¹⁰⁶ Current research indicates the need for a full range of interventions for youths,³⁴ including health promotion,^{35,36} early intervention,³⁸ and long-term supports such as integrated self-management,³⁹ community outreach,⁴⁰ and hospital care.⁴¹ With existing barriers compounded by the COVID-19 pandemic, in-person mental health care is more challenging than ever to navigate and access for youths.¹³ In response, mHealth, a term used to describe the collective set of digital mental health interventions, has been proposed as a solution to meet the needs of youths across the world.

mHealth

In 2022, mobile phone users reached 6.5 billion worldwide, accounting for approximately 80% of the global population. In developed countries such as Canada and the United States, 97% of people own a mobile phone and 85% use a smart phone.^{43,44} Such mass

usage is motivating the rapid growth of medical software and apps for diverse populations, including youths.⁴⁵ These mobile device–based apps cover multiple domains of technologies used to assess, capture, or support areas of health, including physical activity and fitness, diet, emotional and mental health, and health services. mHealth technologies have been used to track vital body signs, such as blood pressure, heart rate, exercise, sleep activity, nutritional values in meals, mental health and wellness, anxiety, and mood.⁴⁷ While the pace of new mHealth technologies is growing rapidly, the regulations and standards for their use have not yet followed. In a recent study of nearly 300 apps for mental health, less than one-third received input from a mental health expert.⁵⁹ There is also little consensus regarding standards for mHealth tools, and determining the effectiveness of mHealth interventions on diverse populations, including youths experiencing mental health challenges.

In summary, the field of mHealth often presents a dichotomy of opportunity and risk. On the one hand, the lack of standards and regulation for mHealth apps presents global concerns for the safety of youths, notably personal security and the uptake of misinformation.^{63–65} On the other hand, mHealth may have an increasingly important role in health promotion, education, and interventions to bridge the gap for those who cannot access in-person services.⁶⁶ A greater understanding is needed to learn about how youths

use mHealth technologies in their daily lives, with specific emphasis on understanding how they navigate safety risks and use these technologies to improve health and wellness outcomes.

The purpose of this scoping review is to synthesize the current evidence supporting mHealth interventions for youths accessing support for mental health challenges. This will facilitate understanding of what is missing in the field of mHealth and support recommendations for research, practice, and policy. The specific objectives are to (a) synthesize the current evidence supporting mHealth interventions for youths who experience mental health challenges and (b) identify current gaps in the mHealth field, with an overarching goal of improving youths' mental health service access, outcomes, and experiences.

3.2 Methods

Overview

We conducted a scoping review to examine the extent, range, and nature of mHealth and to identify gaps in the existing literature on this emerging topic. This scoping study followed the 5 stages of Arksey and O'Malley's scoping study framework¹⁰⁷ to (a) identify the research question; (b) identify relevant studies; (c) select studies; (d) chart the data; and (e) collate, summarize, and report the results.

Step 1: Identify the Research Question

What are the key characteristics and evidence gaps identified in the existing literature on mHealth interventions for youths (aged 12–24 years) with mental health challenges?

Step 2: Identify Relevant Studies

Under the guidance of a medical librarian, a comprehensive search of the following electronic databases was conducted: MEDLINE (Ovid), Embase (Ovid), PsycINFO (EBSCO), and PubMed (see Multimedia Appendix A for example search). We consulted with mHealth stakeholders and youths to decide on the range of dates to search. Our expert team highlighted rapid changes in the field, notably the influence of TikTok after its launch in 2016. To ensure relevance and reference value, we decided to only review articles published during the past 6 years (January 1, 2016, to February 7, 2022) to manage the scope, breadth, and rapidly changing information available. Key terms derived from the research question were selected and expanded to create a comprehensive list of search terms, including “telemedicine,” “telerehabilitation,” “mobile applications,” “mHealth (mobile health),” “eHealth (electronic/digital health),” and “telehealth,” as well as a combination of the following mental health condition-related terms: “mental disorders,” “anxiety,” “depression,” “eating disorder,” “schizophrenia,” “bipolar,” “obsessive compulsive disorder,” and “posttraumatic stress disorder,” along with a list of key terms to define the age group of this review: “adolescent,” “teen,” “youth,” and “young adult.” Combinations of these

terms, along with Medical Subject Heading (MeSH) terms, were tested iteratively in each of the databases selected to inform the new combination of different terms leading to relevant literature. All searches included at least one identifier for mHealth (eg, telehealth and eHealth), 1 identifier for mental health condition (eg, depression and anxiety), and 1 identifier for age range (eg, youth and young adult). The lead author reviewed the title and abstract of each study to determine eligibility based on predetermined inclusion and exclusion criteria (described below) after duplicates were removed. After the completion of the initial review, the articles were thoroughly reviewed by the lead author based on the research topic.

Step 3: Select Studies

The following inclusion criteria were considered: (a) published in English; (b) published between January 1, 2016, and February 7, 2022; (c) included human subjects, whose ages fall between 12 and 24 years; (d) included at least one mHealth intervention tool targeting 1 or more mental health conditions for youths; and (e) referenced literature from peer-reviewed journals and book chapters. Exclusion criteria were as follows: (a) editorial comments, commentaries, book reviews, and opinion articles; (b) incomplete studies (e.g., description of intervention, protocols, ideas from symposia, and conference summaries); (c) articles without full text available.

Relevant systematic reviews were included in the study to serve as background literature but were excluded from the data extraction and analysis process to focus on intervention studies.

Step 4: Chart the Data

Through careful review of the literature, the researcher identified the key components and issues discussed in all relevant studies. This information was recorded in a data extraction sheet, along with information on each study (author, publication year, population demographics, location, study design, level of evidence, characteristics of the intervention, targeted health condition, and outcomes).

Step 5: Collate, Summarize, and Report Results

The information was synthesized and used to map out the scope and breadth of included literature on the topic of mHealth intervention for youths' mental health challenges.

3.3 Results

Overview

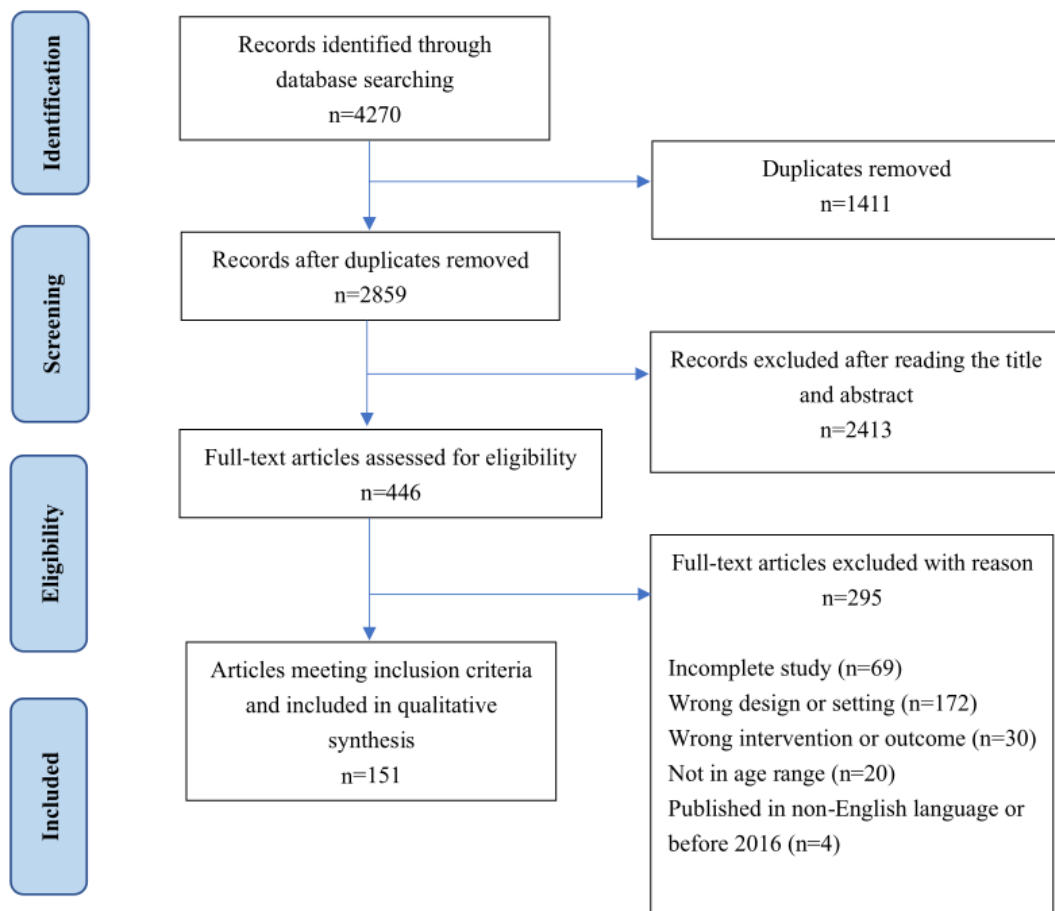
As noted in Figure 5, the search identified 4270 citations for initial screening. A total of 1411 duplicates were removed, resulting in 2859 citations for title and abstract reviews. A further 2413 articles were excluded because their title or abstract did not address mHealth interventions for youths' mental health, leaving 446 citations. After full text review, a total of 151 articles met the inclusion criteria for this study. Table 1

summarizes the countries of origin of the included studies.

Figure 5

PRISMA Diagram Describing the Search Process and Number of Articles Meeting

Inclusion Criteria for This Study (N=151).



Note. PRISMA = preferred reporting items for systematic reviews and meta-analyses.

Table 1*Countries of Origin of Papers Included in the Scoping Review*

Country	Articles (<i>N</i> = 151) <i>n</i> (%)
United States	61 (40)
Australia	28 (19)
Canada	10 (7)
Sweden	10 (7)
United Kingdom	8 (6)
New Zealand	7 (5)
China	4 (3)
Nigeria	3 (2)
Finland	3 (2)
Netherland	3 (2)
Japan	2 (1)
Germany	2 (1)
Korea	1 (1)
India	1 (1)
Spain	1 (1)
Iceland	1 (1)
Denmark	1 (1)
Belgium	1 (1)
Italy	1 (1)
Norway	1 (1)
Israel	1 (1)
France	1 (1)

Level of Evidence

As shown in Table 2, four levels of evidence were adopted to show the power of evidence among included youths' mHealth interventions for mental health research.^{108,109} Study types and designs varied. The highest level of evidence included experimental studies

identified as randomized controlled trials (60/151, 40%). The second highest level of evidence included studies that were nonrandomized trials, such as quasi-experimental design (usually with 2 groups) or 1 group pre-post design (34/151, 23%). The third level of evidence included studies that only conducted feedback surveys to their participants once after the intervention, longitudinal observational studies, and mixed methods design (27/151, 18%). Last, some of the included studies had lower levels of evidence, including descriptive studies, case studies, and qualitative studies describing the outcome of mHealth interventions (30/151, 20%).

Table 2

Design of Studies Included in the Scoping Review

Level of evidence	Study design	Number of articles
I	Randomized controlled trials	60
II	Nonrandomized experimental studies (quasi-experimental, pre-post, and cohort)	34
III	Cross-sectional, longitudinal surveys, and mixed method study with nonexperimental quantitative part	27
IV	Descriptive, case studies, and qualitative studies	30

Age

All included studies have a general targeted age group of “young people,” “adolescent,” or “youth.” The median age for participants in all studies was 17 (IQR 14-21) years, with 2 outliers (with participants aged 61 years¹¹⁰ and 62 years¹¹¹) coming from the studies targeting “university students.”

Sex and Gender

A total of 20 (13%) papers did not provide any statistics on sex or gender. Only 3 (2%) studies involved participants who reported their sex or gender beyond binary options. One study focused on eating disorders and had 1 intersex participant.¹¹² The other 2 studies prioritized mental health in 2-spirited, lesbian, gay, bisexual, transgender, queer/questioning, intersex, and agender (2SLGBTQIA+) groups: 1 included 108 sexual minority young adults¹¹³ and the other included 565 participants with a combination of transgender, genderqueer, gender expansive, intersex, agender, 2-spirited, and third gender identities.¹¹⁴ The remaining 148 (98%) studies had a total of 6478 (34.2%) men and 12,480 (65.8%) women as participants.

Organizational Affiliation

The included studies took place in various settings. They were coded into the following 4 different categories, inspired by Marshall et al⁵⁹: (a) research developed under clinic or hospital-related setting (97/151, 64%); (b) research developed in a university (28/151, 19%); (c) research developed in other non-university schools and institutions (9/151,

6%); and (d) insufficient information to tell (17/151, 11%).

Modes of Delivery of mHealth Interventions

As noted in Table 3, a variety of modes are used to deliver services. These included web pages (54/151, 36%), smartphone apps (51/151, 34%), phone calls and text messages (10/151, 9%), and innovative virtual reality (VR) tools (3/151,2%).

Table 3

Delivery Modes Among Studies Included in the Review

Delivery modes	Studies <i>n</i> (%)	Randomized controlled trial, <i>n/N</i> (%)	Positive ^a results <i>n/N</i> (%)
Webpages	54 (36)	33/54 (61)	48/54 (89)
Smartphone apps	51 (34)	13/51 (26)	40/51 (78)
Video conferencing	20 (13)	3/20 (15)	15/20 (75)
SMS text messages	10 (7)	5/10 (50)	7/10 (70)
Chat-box	4 (3)	2/4 (50)	4/4 (100)
Phone calls	3 (2)	1/3 (33)	2/3 (67)
Virtual reality	3 (2)	0/3 (0)	3/3 (100)
Mixed modes	6 (4)	3/6 (50)	4/6 (67)
Total	151 (100)	60/151 (N/A ^b)	123/151 (N/A)

^aPositive results: Researchers stated overall positive effect of intervention or received positive feedback from users to show promising practical usage of the intervention.

Targeted Conditions

The number and percentage of health conditions targeted using mHealth interventions are summarized in Table 4.

Measurement Approaches Used in the Studies

A wide range of tools were employed to measure outcomes in mHealth intervention research (Table 4).

Table 4

Health Conditions and Measurement Tools Among Included Studies

Health condition	Studies, <i>n</i> (%)	Measurement tools (scales) used
General health	26 (15)	66
Anxiety	35 (20)	52
Depression	32 (19)	68
Suicide, self-harm, or violence	11 (6)	15
Substance use	10 (6)	22
Eating disorder	10 (6)	10
Stress or mood related	9 (5)	20
Sleep disorder	6 (4)	9
ASD	5 (3)	4
STD or STI	5 (3)	10
Psychosis	4 (2)	5
ADHD	4 (2)	8
PTSD	4 (2)	3
OCD	3 (2)	1
FASD	2 (1)	N/A ^g
Others	6 (4)	N/A
Total	172 (N/A)	N/A

Note. ASD = autism spectrum disorder; STD or STI = sexually transmitted disease or

sexually transmitted infection; ADHD = attention-deficit/hyperactivity disorder; PTSD = posttraumatic stress disorder; OCD = obsessive-compulsive disorder; FASD = fetal alcohol spectrum disorder; N/A = not applicable. The total number of conditions exceeds the total number of studies because some articles targeted more than one condition.

COVID-19

Of the 151 studies included within the given time period, 68 (45%) were published after the COVID-19 outbreak, with most (44/151, 65%) published in 2020. The numbers of studies published each year are as follows: 11 studies in 2016; 21 studies in 2017; 19 studies in 2018; 32 studies in 2019; 44 studies in 2020; 23 studies in 2021; and 1 study in February 2022. The following 8 studies directly addressed health conditions or service delivery modalities influenced by the pandemic: (a) treatment of eating disorders in adolescents;¹¹⁵ (b) group-based psychiatric care using telehealth;¹¹⁶ (c) a web-based art therapy group for learning disabled young adults using WhatsApp;¹¹⁷ (d) telehealth versus in-person intensive outpatient program (IOP) for eating disorders during versus before COVID-19;¹¹² (e) a well-being app to support young people living in New Zealand;¹¹⁸ (f) peer-to-peer live-streaming intervention to promote physical activity and reduce anxiety during homeschooling;¹¹⁹ (g) a mindfulness-based mHealth intervention

among psychologically distressed university students in quarantine;¹²⁰ and (h) smartphone application for adolescents with anorexia nervosa.¹²¹

3.4 Discussion

Overview

This scoping review provides a comprehensive synthesis of mobile mental health intervention research for youth. The study identified that the number of interventions is proliferating over time, with limited emphasis on study quality, youth engagement, youth-centred outcome assessment, implementation standards, or consideration for equity, diversity, and inclusion in research. Youth engagement was rarely mentioned as a part of any research study method, and most studies focused primarily on youth that identified within the gender binary. Few studies discussed the implementation and scale of interventions in diverse settings (Table 3) and even fewer studies showed an impact of mHealth interventions over time for diverse types of youth. With significant growth and investment in the area, this review may inform direction for future research and advance practices within mHealth intervention approaches for youth who experience mental health challenges or illnesses.

Among the studies that met the inclusion criteria, depression (32/151, 19%), anxiety (35/151, 20%), and general mental health concerns (26/151, 15%) accounted for over half of the studies, and the remaining addressed 17 other mental health concern categories.

According to a GBD systematic analysis of mental health conditions relevant to this study, the top concerns for all youth are self-harm, depressive disorders, interpersonal violence, anxiety disorders, HIV/AIDS, conduct disorder, and drug use disorder.¹²² The point estimate of alcohol and drug use disorders combined is very close to the prevalence of depression, serving as 2 of the most concerning mental health disorders worldwide.¹²³ The high prevalence of depressive and anxiety disorders corresponds with the allocation of research priorities in studies included in this review, suggesting the current focus for youth mental health care services. Nevertheless, while self-harm and interpersonal violence ranked high on the GBD mental health conditions list, there were comparatively limited research studies for these categories. Substance use disorders are also underrepresented in existing mHealth studies for youth. More attention and resources should be given to the development of mHealth intervention tools targeting self-harm, interpersonal violence, and substances use among diverse youth.

From a global health perspective, 95% (143/151) of studies came from developed countries. This result is not surprising, as mHealth resources are almost exclusively concentrated in high-income countries, although the prevalence of depression and anxiety in high-income countries is not significantly higher than in the rest of the world.¹²⁴ Therefore, more future mHealth research needs to be conducted in low- and middle-income countries, especially when one of the advantages of remote health care access is

cost-effectiveness. Previous studies have demonstrated adapting interventions developed in high-income countries for use in low- and middle-income countries, such as India, Sierra Leone, Romania, Malaysia, and South Africa;^{125,126} these lessons could be adapted for mHealth interventions for youth mental health.

Delivery Modes

With respect to delivering mHealth interventions, most studies employed webpages (54/151, 36%) and smartphone apps (51/151, 34%), and these modes also had the largest number of randomized controlled trials conducted. The results show web-based mHealth tools have the strongest evidence for improving mental health conditions in youth, but the effectiveness of other intervention modes cannot be ruled out. Web-based intervention tools require youth to have internet access, and the use of computers may not be convenient in home and school settings, so the development of mHealth interventions has gradually evolved to include smartphones, smart devices, wearables, and newer technologies, including VR and augmented reality.¹²⁷ However, with the rising number of options available for mHealth intervention delivery, youth's intention to use has become a more complicated question. Currently, many studies contributing to the adoption research of mHealth for youth are based on the technology acceptance model, an information systems theory that models user's acceptance of technology mainly based on perceived usefulness and perceived ease of use.^{68,70,71} Yet, it is essential to realize that participants

in research studies are provided with a predetermined type of intervention by the researchers, often with limited youth engagement. That is, unlike in a real-world environment where diverse users who need support must seek it themselves, participants in the research settings did not actively choose which kind of mHealth intervention to use. Therefore, future studies need to consider the youth-intended delivery modes during mHealth intervention development from a user perspective, especially when considering innovative technologies, such as VR, artificial intelligence chat, and gaming. Future research should also consider implementation research, not only to understand the efficacy and effectiveness of the interventions but also their capacity to be sustained over time in diverse settings.

Measurement

The measurement tools used in the studies can be broadly defined as either (a) measuring the outcome of a patient's condition or (b) measuring the subject usability of a product or service. As displayed in Table 4, depression, anxiety, and general mental health categories each adopted more than 50 measurement tools. The review also identified numerous measurement scales used for each health condition. For example, 7 sleep-relevant measurements were used in 6 sleep-related citations,^{128–133} but the researchers did not provide a rationale as to why they chose the scale used among all available sleep-related measurements, nor was evidence provided about the fitness of the

tools for youth in the varying contexts. Similar complications were presented in other included studies with varying health conditions. Future research should focus on developing a guideline for researchers to follow when selecting the most appropriate measurement scales in both research and clinical settings and on validating measurement scales designed for use with youth with consideration for equity, diversity, inclusion, and psychometric rigor.

Evaluation of mHealth Products

The percentage of positive results is considerably high among all included studies (123/151, 81%). Study aims included “feasibility,” “effect,” “acceptability,” “efficacy,” “fidelity,” “effectiveness,” and “cost-effectiveness,” with research designs including experiments, surveys, and interviews. Questions remain as to whether positive results translate to real-world applications or which types of outcomes possess high level of evidence in the knowledge translation process for health care services. In a Canadian study where participants were asked to rate mHealth apps objectively, results were highly variable, and 28% of reviewers were not even sure about the overall quality of the health product.¹³⁴ The same characteristics in different studies also vary within a wide range. For instance, the intervention durations ranged from as short as 7 days¹³⁵ or 2 sessions¹³⁶ to as long as 24 weeks¹³⁷ or 24 months.¹³⁸ The number of participants among all studies

ranges from 2¹³⁹ to 2532.¹⁴⁰ Intervention types also varied significantly. Such variations raise concerns about the lack of a standardized evaluation strategy. To address the complex uncertainty in evaluating mHealth tools, a multifaceted evaluation framework needs to be adopted to assess the different perspectives, elements, and features of an intervention that leads to a final mHealth product. Using non–youth-centred frameworks to evaluate mHealth products can consequently produce ambiguous or incorrect information on their effectiveness, leading to misuse, misdiagnosis, wasted time, and, worst of all, negative health impacts and experiences.¹⁴¹

Remote Care Transition

Several included studies discuss how to support youth during the COVID-19 pandemic.¹⁴² With many people transitioning to work-from-home or hybrid arrangements during and after the pandemic, there arose an imminent need for a mental health technology revolution, and web-based health service delivery has emerged as a preferred tool.¹²

Childs and colleagues¹¹⁶ illustrated the feasibility of a rapid transition to telemedicine services during the pandemic. Yale New Haven Psychiatric Hospital decided to discontinue in-person IOP services within 3 business days of the World Health Organization’s pandemic declaration.¹¹⁶ The first mobile service was available within a week, and subsequent treatment plans and adolescent ambulatory services were

developed to reach IOP level. The study demonstrated that it took a comprehensive program 2 months to transition from 100% in-person service pre-pandemic (March) to 100% telehealth service after the start of the pandemic (May 2020), showing the feasibility of the deployment of mHealth tools in clinical settings and the smooth transition from physical to virtual health care access. One notable limitation of this study is that the clinicians focused on the transition process rather than the effectiveness of the intervention tool.

Another youth mHealth intervention study showed the transition to virtual services was not always desired by clients. The authors presented a case where a participant refused to cooperate, and the telemedicine service increased the tension between the participant and family members.¹¹⁵ When developing mHealth interventions targeting youth mental health, it is important to consider how to achieve optimal patient engagement when physical contact with a service provider is not an option. Last, it is still unknown whether these transitioned services will continue to be provided virtually on an ongoing basis. Future research is needed to investigate the long-term influence of such transitions and determine the feasibility of normalizing mHealth services.

Youth and Stakeholder Engagement

Engagement with mHealth interventions is thought to be important for intervention

effectiveness by increasing acceptability, satisfaction, intervention adherence, and levels of attention and enjoyment.¹⁴³ This can be extended to engaging youth in mHealth research to provide comprehensive, ongoing, tailored, and interactive support to improve health.¹⁴⁴

Current youth mHealth research often engages youth by asking for feedback in a survey or interview to test usability, feasibility, and acceptability,^{111,145,146} or by including youth users as participants in experiments to evaluate the effectiveness and efficiency of an intervention. However, few studies mentioned how they engaged youth in the development phase and followed design thinking with the priority population. Youth and other stakeholders (e.g., family and caregivers, service providers, graphic designers, etc.) can contribute more than just feedback on the provided services; they can be offered opportunities to participate in the product and service design stages to make sure the end product is tailored to their needs and preferences. A previous conceptual model indicated that, during the optimization phase of an intervention,¹⁴⁵ participants need to understand how the provided materials can inspire them and facilitate their thoughts to improve self-efficacy, which increases capability for self-monitoring and self-regulation and can lead to improved health outcomes and behavioural changes.^{145,146} Researchers proposed a supportive accountability model that emphasized the importance of human support in mHealth interventions to increase adherence to trustworthy, benevolent, and professional

information.¹⁴⁷ To summarize, it is crucial to apply such theoretical models to interventions targeting youth mental health as well. mHealth researchers and developers ought to involve youth in every stage of design, development, and implementation. Our team is currently studying youth engagement in the mHealth development phase to understand youth information preferences and make sure mHealth interventions are designed to convey the benefits of human support, similar to in-person services.

Policy

More than two-thirds of the studies took place in a clinical setting, yet none of the studies reviewed provided systematic frameworks or models to help translate, scale, and sustain available mHealth tools to clinical practice. If health care stakeholders and policy makers aim to scale up and normalize mHealth services in the near future, it is essential to understand the feasibility and impact of implementing new mHealth tools in current models of care (eg, health care, schools, etc). Guidelines and standards may be critical to ensuring that mHealth interventions are trustworthy and can be value added to health services that are delivered to youth and their families.

Strengths and Limitations

This review has a broad scope of attempting to draw a picture of existing mHealth intervention tools specifically designed for younger populations and how their effectiveness is being assessed. This scoping review addressed a broad term list and a

large number of parameters. Inclusion and exclusion criteria were strictly set from the beginning and determined by experts in the field and a medical librarian, and diversity is presented for all included studies. There are unlimited possibilities for future work, particularly with the uncertainty of the COVID-19 pandemic and the ongoing response of the health care system to remote health access. Regarding weaknesses, the lack of critical appraisal is a widely recognized limitation for scoping reviews.¹⁴⁸ The scope of this review may be broad, but the depth and the quality of all included papers were not systematically critiqued. We also acknowledge that our search strategy may have missed key terms (eg, internet-based interventions) and intervention descriptions (eg, asynchronous vs synchronous) that may have limited our ability to completely summarize all relevant articles. In addition, the COVID-19 pandemic has not come to an end, and there is still ongoing research about long-term COVID symptoms. Thus, the results relevant to remote care transition and COVID-19 should be interpreted with some caution.

3.5 Conclusion

As the need for mental health services continues to accelerate, mHealth technologies provide a solution to support diverse youth who may not be able to access in-person services. The impact of mHealth interventions on youth mental health has been

increasingly recognized by researchers, service providers, and policy makers. Results of our scoping review demonstrate a range of studies that capture the exponential growth of mHealth interventions for youth, with significant potential to be value-added for youth who are seeking support for mental health challenges. However, the review also highlighted important gaps in research that include youth voice throughout the research process, notably diverse youth in both developing and developed countries. Future research is needed that adopts an equity, diversity, and inclusion lens, prioritizes understanding how current mHealth technologies can be adopted into existing models of care, and develops guidelines, standards, and evaluation frameworks to support future mHealth development and implementation. As the field continues to expand rapidly, more global resources are needed to monitor technological advancements to provide quality mHealth services to every youth where and when they need them.

Chapter 4: Study 2 Quantitative Analysis

Virtual, In-Person, and Hybrid Utilization Patterns of Youth Accessing Integrated Youth Services: A Retrospective Cohort Study of Youth Aged 12–24

This paper has been submitted for peer review and is under consideration for publication.

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Summary

Introduction. Youth mental health and substance use (MHSU) concerns are escalating globally, as are barriers to timely access to culturally and developmentally appropriate care. Integrated youth services (IYS) are emerging as a solution that includes access to both in-person and virtual services. The research objectives were to: (a) understand the service utilization patterns among an IYS youth cohort, and (b) differentiate the demographic and clinical characteristics of youth who have accessed accessing different types of service delivery modalities.

Methods. We reviewed records of 41,034 youth aged 12–24 years who accessed an IYS initiative from April 2020 to November 2023. Data included demographic and health

surveys completed by youth when they registered and service records after session completion. Descriptive and inferential statistical analysis methods were used for analysis.

Results. Youth accessed IYS through virtual, in-person, and hybrid modalities. Younger youth (aged 12–14) accessed more in-person services than older youth (aged 21–24), who were more likely to access virtual option only. Youth who accessed virtual services reported high distress scores and poorer general health and mental health status than other groups. Youth who used the hybrid option reported the highest rate of repeat visits.

Twenty five percent of all youth said that they would have “gone nowhere” if it were not for the IYS initiative.

Conclusion. This study highlights the importance of recognizing demographic and clinical differences among the various ways youth access health and wellness services.

There is a need to ensure continuous evolution of the IYS to meet the needs of youth across contexts and service delivery methods.

4.1 Introduction

Addressing youth mental health and substance use (MHSU) is a growing priority across Canada and many parts of the world.¹⁶ Over the past decade, there has been a substantial increase in mood and anxiety disorders, notably among individuals aged 12–24.¹⁴⁹ In the absence of early intervention or treatment, this age group, defined

collectively as *youth* in this paper, has been shown to be at risk for poor health and social outcomes.^{150,151} An estimated 70% of MHSU problems in youth living in Canada have an onset between the age of 12 to 24.^{7,152} Engaging youth early in their health trajectory remains crucial for preventing the development of more severe issues, reducing stigma, improving long-term outcomes, and ensuring youth have the supports and services they need to thrive.^{33,37,106}

Despite the growing recognition of mental health as a priority by decision-makers, Canada still lacks accessible, integrated, and low-barrier mental health services.¹⁵³ In response, integrated youth services (IYS) have been proposed as a solution^{154,155} to reduce structural barriers (e.g., wait times, costs, service fragmentation) to MHSU service access. IYS integrate evidence-based health and wellness services through a single access point, including practices of local knowledge experts in the specific context.

Building community-embedded IYS requires a multifaceted approach that prioritizes youth and family co-design, coordinated implementation of services and evaluation procedures, and, typically, participation in a network of IYS communities who share a vision to improve youth health and social outcomes.¹⁵⁶ The province of British Columbia (BC) has rapidly scaled IYS by building a BC-IYS initiative called Foundry, a collaborative initiative involving youth, families, and over 200 government and nonprofit

partners who support centre development and implementation in 35 communities (17 operating, 18 in development in late 2024).

Foundry launched its provincial virtual service during the COVID-19 pandemic, allowing youth to access online health resources and schedule and attend appointments with service providers using chat, audio calls, or video calls. The provincial virtual service remains active and, as with in-person services at the centres, can be used as a low-barrier approach to health services, peer support programs, and community-based outreach initiatives, such as work and education services.

Although virtual health services have gained considerable attention in Canada, there are knowledge gaps in elements of virtual health services, including the role of virtual services for health promotion, education, and early intervention to bridge the gap for those youth who cannot access in-person services.¹⁵⁷ Because youth are generally more open to using innovative technology than other age groups are,¹⁵⁸ they are an ideal group to study to understand the impact of virtual platforms to improve MHSU outcomes and experiences. Implementing virtual services in an IYS network setting such as Foundry creates opportunities to mitigate health resource disparities and revolutionize health care service delivery and outcomes for youth. However, this approach has also been criticized. For example, the lack of standards and regulation for virtual services presents global concerns for the safety of youths, notably personal security and the uptake

of misinformation.¹⁷ Nevertheless, youths' familiarity with technology and general preference for online communication make it increasingly important for researchers, service providers, and policymakers to understand how virtual MHSU services can effectively and safely reach and engage youth in their health journeys.

Within the IYS context, it is important to understand the service utilization patterns among youth. Foundry is a maturing IYS initiative in Canada, and data exist about the implementation of virtual services, creating an ideal opportunity to understand how the BC-IYS initiative has been used over time to increase accessibility to coordinated services that meet the diverse needs and preferences of youth. A nuanced understanding of the overarching service utilization pattern can help decision makers allocate available resources appropriately, thereby supporting sustainability in both physical centres and virtual service design and development within the IYS framework. Moreover, deeper knowledge of the multifaceted factors influencing the utilization of virtual IYS can give decision makers the necessary insights to tailor services to meet the specific needs of distinct demographic and clinical cohorts, such as the feasibility of personalizing MHSU care options based on demographic and clinical profiles.

Hence, the objectives of this study were to (a) compare the demographic and clinical characteristics of youth who had accessing three types of service modalities (virtual, in-person, and hybrid), and (b) understand their service utilization patterns

(number and frequency of visits, repeated visits rate, new registrations) among an IYS youth cohort. I hypothesized that there would be no differences in the demographic and clinical characteristics, or service delivery patterns of youth accessing the three types of service modalities.

4.2 Methods

4.2.1 Study Setting

This was a retrospective cohort study using data from youth (aged 12–24) who registered for Foundry ($n = 16$ centres operational at end of study period plus provincial virtual service) between April 1, 2020, and November 30, 2023. Foundry integrates five core service streams: physical and sexual health, mental health, substance use support, peer support, and social services. Foundry services are delivered by teams of interdisciplinary health care professionals (e.g., physicians, nurses, counsellors, occupational therapists, peer support workers). Foundry launched its virtual service in April 2020, allowing youth to access online health resources; schedule appointments with service providers; and communicate with service providers using chat, audio calls, or video calls.

4.2.2 Data Collection

This study was a secondary data analysis of an existing survey-based data set collected by Foundry. Note that participants were not assigned to service modalities

(virtual, in-person, or hybrid). Instead, data were collected from a naturally occurring cohort of youth who accessed services at Foundry BC. This approach reflects real-world patterns without experimental manipulation. Foundry collects self-reported sociodemographic data and health measures, along with clinical service usage data, among youth accessing services. Self-reported sociodemographic data are collected via surveys during service visits (i.e., the initial visit to any of Foundry's centres or provincial virtual service). The surveys capture age, self-identified gender, sexual orientation, living situation, educational/vocational status, mental health service access history, self-rated health and mental health, K10 distress score¹⁵⁹, general reason for visit, how the youth found out about Foundry, and where they would have sought services had a Foundry centre not been available to them. Service count and type data are collected and calculated from the end of every service visit form. These data are collected for research and evaluation, aiming to provide insights into Foundry's service design and delivery and areas for improvement.

Ethical approval was received from the University of British Columbia Office of Research Ethics Behavioural Research Ethics Board (H23-03606). All data were collected in accordance with all relevant laws, including the Freedom of Information and Protection of Privacy Act (FIPPA) and the Personal Information Protection Act (PIPA), for the purposes of service delivery, evaluation, and research. Youth were informed of

this prior to survey completion, and did not have to complete any surveys to receive services (i.e., completion of the surveys is voluntary). Youth voluntarily consented to the data being used for research purposes by indicating they had read and understood the purpose of the survey and how data are collected, stored, and reported. Data were de-identified, stored, accessed and analyzed in a secure research environment.

4.2.3 Analysis

Three main groups were studied: The *virtual group* were youth who exclusively visited Foundry through Foundry Virtual BC or another virtual mode of services with service providers (e.g., via Zoom or phone call). In cases where services were accessed virtually within physical centres, the end-of-visit forms were updated with the virtual flag in the mode of visit variable. *In-person group* were youth who visited exclusively in person at physical Foundry centres. The end-of-visit forms corresponding to their visits did not have the virtual flag in the mode of visit variable. The *hybrid group* consisted of youth who had both virtual and in-person visits as described above within the study period.

To compare differences in demographic characteristics, health profile characteristics, and service access across three groups (virtual, in-person, and hybrid), Welch's ANOVA was applied to numeric variables (i.e. Age and K10 numeric score). The variances for these numeric variables across the three groups were determined to be

unequal based on the variability in the samples, which was confirmed by Levene's test for homogeneity of variances ($p < 0.05$). Welch's ANOVA reduces the effect of heteroscedasticity across these samples by adjusting both the test statistic and the degree of freedom. When significant differences were identified ($p < 0.05$), Games-Howell tests provided post-hoc pairwise comparisons. Post-hoc differences were determined based on adjusted p-values using Tukey's method (adj. $p < 0.05$) to control for Type I error.

Pearson's chi-squared tests of independence were performed to examine the associations between the categorical and grouping variables. When significance was identified ($p < 0.05$), post-hoc comparisons of proportions across samples were carried out with standardized residuals, with significance determined for each cell based on Bonferroni-adjusted p-values. Since multiple comparisons were made, the Bonferroni correction was applied to control for Type I error. Specifically, the alpha level of 0.05 was adjusted based on the number of comparisons conducted.

All analyses were performed using R Statistical Software (v4.2.2; R Core Team 2022) and the tidyverse R package (v2.0.0).¹⁶⁰ Descriptive analyses of demographic characteristic, health profile characteristic, and service access data were conducted using the R packages gtsummary (v1.7.2),¹⁶¹ rstatix (v0.7.2),¹⁶² and chisq.posthoc.test (v0.1.2).¹⁶³

4.3 Results

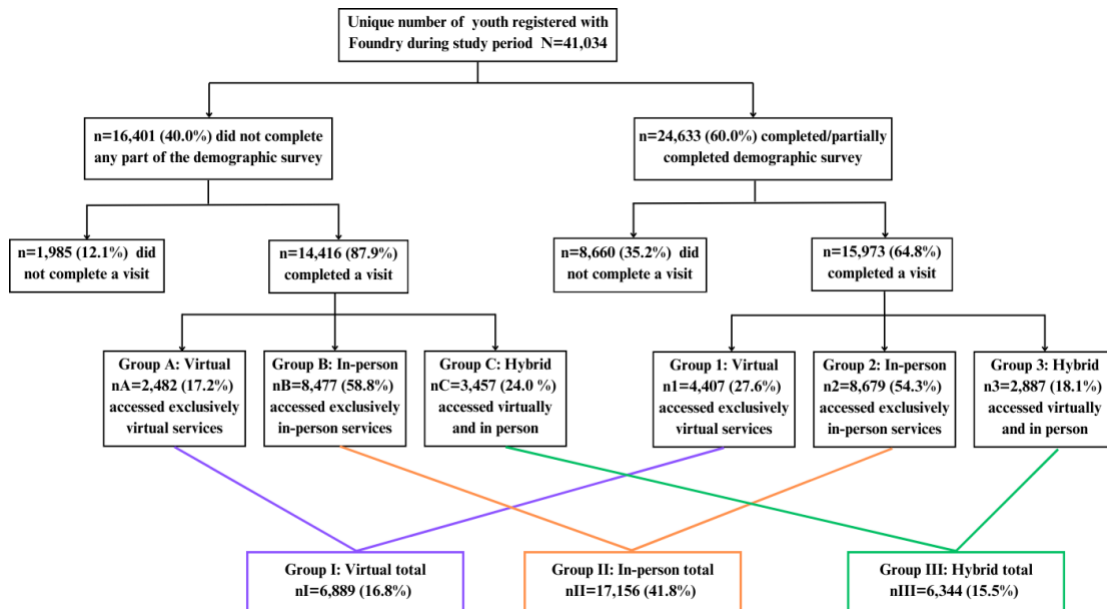
A total of 41,034 unique youth registered at Foundry during the study period (April 1, 2020, to November 30, 2023). Completing the sociodemographic and health survey was not a mandatory prerequisite for accessing care, allowing youth the option to skip questions when registering. Consequently, the study cohort was composed of two major parts: those who fully or partially completed the demographic and health survey ($n = 24,633$, 60.0%), and those who did not complete any parts of the survey at all ($n = 16,401$, 40.0%). Last, 10,645 (1,985 from the no-survey group and 8,660 from the survey group; 25.9% of all registered youth) youths from both major parts registered for Foundry, but did not access any services during study period. Youth who did not access any service were not included in any data analysis in this study.

For the first research objective comparing the demographic and clinical characteristics among youth who accessed service from three different modalities, we used the data from youth in three nonoverlapping groups: Groups 1, 2, 3 (see Figure 6) who provided their information from surveys. Group 1: Virtual ($n_1 = 4,407$, 27.6%) included youth who exclusively accessed Foundry's provincial virtual service. Group 2: In-person ($n_2 = 8,679$, 54.3%) included youth who exclusively accessed services by in-

person visits at Foundry centres. Group 3: Hybrid ($n_3 = 2,887$, 18.1%) included youth who accessed services both virtually and in person.

Figure 6

Description of Groups in Study Cohort



Note. Groups A–C ($n = 14,416$) represent youth who completed a visit, but did not complete any part of the demographic survey. Groups 1–3 ($n = 15,973$) include youth who completed a visit and also completed or partially completed demographic survey information as part of their visit. Groups I–III ($n = 30,389$) include total youth in each group regardless of their survey completion status.

For the second research objective aiming to understand the overall service utilization patterns across three groups (regardless of the voluntary completion of the sociodemographic or health survey), we examined the overall end-of-visit statistics collected by the organization. Service utilization data from all youth who accessed the services, including Groups 1, 2, 3, and Groups A, B, C (Figure 6) were analyzed.

For the overall analysis for service utilization the groups were:

Virtual Total

Group I = Group A + Group 1 ($nI = 6,889$, 16.8% of all registered youth) included all youth who exclusively accessed Foundry's provincial virtual service.

In-Person Total

Group II = Group B + Group 2 ($nII = 17,156$, 41.8%) included all youth who exclusively accessed services by in-person visits at Foundry centres.

Hybrid Total

Group III = Group C + Group 3 ($nIII = 6,344$, 15.5%) included all youth who accessed services both virtually and in person.

Sociodemographic and Clinical Characteristics

The sociodemographic characteristics of the study cohort are presented in Table 5. The mean age of youth accessing all services was 18.3 ($SD = 3.3$). A Welch's ANOVA revealed that there was a significant difference in age among the three groups ($F(2, 7186)$

= 278.62, $p < 0.001$). Games-Howell tests indicated that Group 1 (virtual) was significantly older ($M = 19.1$, $SD = 3.2$) compared to Group 3 (hybrid) ($M = 18.8$, $SD = 3.1$) ($p < 0.001$, $t = 4.3$, $M_d = -0.3$, 95% CI [-0.5, -0.2]), and Group 2 (in-person) ($M = 17.8$, $SD = 3.3$) was younger than Group 3 ($p < 0.001$, $t = 14.5$, $M_d = 1$, 95% CI [0.8, 1.2]). A chi-square test of independence showed a significant association between group and age categories ($X^2(8, N = 15978) = 525.18$, $p < 0.001$). Standardized residuals showed that youth accessing in-person services exclusively tended to be younger (aged 12–14, 19.6%, $p < 0.001$, $r = 16$) (age 15-17, 28.2%, $p < 0.001$, $r = 9.8$). Meanwhile, those accessing virtual services only tended to be older (age 18-20, 31%, $p = 0.002$, $r = 3.8$) (age 20-23, 31%, $p < 0.001$, $r = 11.7$) (age 24+, 6.7 %, $p < 0.001$, $r = 6.5$). More youth identified as female (56.6%) compared to male (26.3%) among all groups. For those who identified outside of a gender binary or preferred not to answer, there was a consistent trend towards youth making up a higher percentage of those accessing virtual services (19.5%) compared to those accessing in-person services (15.0%).

A chi-square test of independence demonstrated association between the mode of visit and where youth would have gone if Foundry service was unavailable ($X^2(20, N = 14695) = 496.02$, $p < 0.001$). A large proportion ($n = 4038$, 25.3%) of youth from all three groups reported that they would have gone nowhere to get help if Foundry were unavailable to them. Post-hoc analysis of standardized residuals indicated that the

percentage of Group 1's youth who reported accessing other online support if Foundry was not available were significantly higher than expected (7.8%, $p < 0.001$, $r = 12.1$). In contrast, this percentage tended to be lower for youth accessing in-person (3.4%, $p < 0.001$, $r = -7.9$) or hybrid services (3.3%, $p = 0.005$, $r = -3.8$). This distinction between the virtual group and the other two groups continued in the percentage of respondents answer that they would access a walk-in clinic if Foundry was not available. This proportion for the virtual group was significantly lower than expected (4.4%, $p < 0.001$, $r = -14.6$), but higher than expected for the in person (12.4%, $p < 0.001$, $r = 10.5$) and hybrid groups (11.8%, $p = 0.03$, $r = 3.3$), showing a consistent and intrinsic utilization preference.

Youth who sought both virtual and in-person services demonstrated higher service access rates (43.8%) over the past year compared to those who exclusively used virtual (35.7%) or in-person (29.1%) services. This potentially indicates elevated help-seeking motivation or comfort with service types among hybrid service users.

Table 5

Demographic Characteristics of Study Cohort

Characteristic	Group 1 (virtual)	Group 2 (in person)	Group 3 (hybrid)	<i>p</i>
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	<i>n</i> = 4407	<i>n</i> = 8679	<i>n</i> = 2887	
Age (<i>M</i> , <i>SD</i>)	19.1 (3.2)	17.8 (3.3)	18.8 (3.1)	< .001
Min	12	12	12	
Q1	17	15	16	
Median	19	18	19	
Q3	22	20	21	
Max	24	24	24	
Missing	54 (1.2%)	95 (1.1%)	26 (0.9%)	
Age Categories, <i>n</i> (%)				< .001
12–14	<u>435 (9.9)</u>	1,697 (19.6)	<u>323 (11.2)</u>	
15–17	<u>889 (20.2)</u>	2451 (28.2)	679 (23.5)	
18–20	1368 (31.0)	<u>2350 (27.1)</u>	893 (30.9)	
21–23	1368 (31.0)	<u>1755 (20.2)</u>	812 (28.1)	
24	293 (6.7)	<u>331 (3.8)</u>	154 (5.3)	
Missing	54 (1.2)	95 (1.1)	26 (0.9)	
Identity ^a <i>n</i> (%)				< .001
Female	2563 (58.2)	<u>4812 (55.4)</u>	1665 (57.7)	
Male	<u>983 (22.3)</u>	2571 (29.6)	<u>647 (22.4)</u>	
Nonbinary	279 (6.3)	<u>427 (4.9)</u>	170 (5.9)	
Trans female	67 (1.5)	109 (1.3)	49 (1.7)	
Trans male	137 (3.1)	<u>230 (2.7)</u>	144 (5.0)	
Two spirit	12 (0.3)	23 (0.3)	13 (0.5)	
Agender	29 (0.7)	44 (0.5)	17 (0.6)	
Not sure/questioning	155 (3.5)	200 (2.3)	88 (3.1)	
Don't identify with any of these options	115 (2.6)	<u>125 (1.5)</u>	47 (1.6)	
Prefer not to answer	48 (1.1)	92 (1.1)	24 (0.8)	
Missing	19 (0.4)	46 (0.5)	23 (0.8)	
Sexual orientation, <i>n</i> (%)				< .001
Heterosexual	<u>1907 (43.3)</u>	4167 (48.0)	1210 (41.9)	
Gay or lesbian	267 (6.1)	<u>387 (4.5)</u>	156 (5.4)	
Bisexual	936 (21.2)	<u>1678 (19.3)</u>	711 (24.6)	
Asexual	95 (2.2)	174 (2.0)	62 (2.2)	
Questioning	277 (6.3)	<u>410 (4.7)</u>	168 (5.8)	
Prefer not to answer	305 (6.9)	685 (7.9)	214 (7.4)	
Not sure/other	268 (6.1)	536 (6.2)	185 (6.4)	
Missing	352 (8.0)	642 (7.4)	181 (6.3)	
Citizenship ^b <i>n</i> (%)				< .001
Permanent resident	<u>3855 (87.5)</u>	7834 (90.3)	2634 (91.2)	
Temporary resident	230 (5.2)	<u>254 (2.9)</u>	93 (3.2)	
Prefer not to answer	22 (0.5)	46 (0.5)	12 (0.4)	

Not sure	<u>23 (0.5)</u>	136 (1.6)	22 (0.8)
Missing	277 (6.3)	409 (4.7)	126 (4.4)
Go where if Foundry service was unavailable, <i>n</i> (%)			
Cultural/spiritual support person	15 (0.3)	38 (0.4)	14 (0.5)
Emergency services	113 (2.6)	<u>71 (0.8)</u>	41 (1.4)
Family members/friends	1079 (24.5)	1961 (22.6)	<u>573 (19.9)</u>
Hospital emergency	165 (3.7)	<u>241 (2.8)</u>	121 (4.2)
My health care provider	<u>434 (9.9)</u>	1100 (12.7)	359 (12.4)
My school counsellor/teacher	338 (7.7)	806 (9.3)	233 (8.1)
My worker ^c	<u>24 (0.5)</u>	96 (1.1)	38 (1.3)
Nowhere/wouldn't have gotten help	1213 (27.5)	<u>2047 (23.6)</u>	778 (27.0)
Online support	345 (7.8)	<u>297 (3.4)</u>	<u>95 (3.3)</u>
Walk-in clinic	<u>195 (4.4)</u>	1072 (12.4)	340 (11.8)
Other	114 (2.6)	262 (3.0)	77 (2.7)
Missing	372 (8.4)	688 (7.9)	218 (7.6)
Have a family doctor, <i>n</i> (%)			
Yes	2742 (62.2)	5541 (63.8)	1664 (57.6)
No	960 (21.8)	<u>1718 (19.8)</u>	758 (26.3)
Not sure	388 (8.8)	878 (10.1)	285 (9.9)
Missing	317 (7.2)	542 (6.2)	180 (6.2)
Accessed MHSU services in the last year, <i>n</i> (%)			
Yes	1574 (35.7)	<u>2524 (29.1)</u>	1264 (43.8)
No	1959 (44.5)	4386 (50.5)	<u>1023 (35.4)</u>
Not sure	560 (12.7)	1229 (14.2)	437 (15.1)
Missing	314 (7.1)	540 (6.2)	163 (5.7)

Note. Bold values indicate percentages that were significantly higher than expected.

Underlined values indicate percentages that were significantly lower than expected.

^a At Foundry, the survey asks, “I identify as…” and includes the listed options, which include both sex and gender.

^b Permanent resident includes Canadian citizens and permanent residents; temporary resident includes those on a student visa or work visa, visitors to Canada, and refugee claimants.

° Refers to a personal worker, also called a personal support worker.

The health profile from youth across the three groups in the study cohort with self-reported health status, self-reported mental health status, and distress scores (as measured by the K10) is described in Table 6. Across the entire cohort, most youth reported “fair to good” *health* status and “poor to fair” *mental health* status. The group exclusively accessing in-person services reported both better health (Very Good: 15.2%, $p < 0.001$, $r = 6.4$; Excellent: 3.9%, $p < 0.001$, $r = 6.6$) and mental health compared to the other two groups. Just over 57% of youth in Group 2 (in-person) reported “good,” “very good,” and “excellent” general health compared to 49.8% in the virtual group and 50.0% in the hybrid group. Similarly, regarding self-reported mental health, 23.2% of youth in the in-person group reported “good,” “very good” and “excellent” mental health compared to 11.3% in the virtual group and 15.0% in the hybrid group. Notably, virtual (44.9%) and hybrid (41.7%) groups both had a higher percentage of poor mental health compared to the physical in-person group (31.1%). Youth in Group 1 (virtual) also reported the highest percentage (63.2%) of the K10 score category meaning “very high level of psychological distress,” followed closely by Group 3 (hybrid, 59.9%), and then by youth in Group 2 (in-person, 49.2%). At the same time, youth in Group 2 have lower

self-reported (scoring between 10-21) K10 scores (17.3%) compared to Group 1 (7.1%) and Group 3 (10.8%).

Table 6

Health Profile of the Study Cohort

Characteristic	Group 1 (virtual) <i>n</i> = 4407 <i>n</i> (%)	Group 2 (in person) <i>n</i> = 8679 <i>n</i> (%)	Group 3 (hybrid) <i>n</i> = 2887 <i>n</i> (%)	<i>p</i>
Self-rated health				< .001
Poor	415 (9.4)	<u>586 (6.8)</u>	268 (9.3)	
Fair	1462 (33.2)	<u>2512 (28.9)</u>	972 (33.7)	
Good	1589 (36.1)	3322 (38.3)	1042 (36.1)	
Very good	<u>515 (11.7)</u>	1319 (15.2)	<u>336 (11.6)</u>	
Excellent	<u>88 (2.0)</u>	341 (3.9)	65 (2.3)	
Missing	338 (7.7)	599 (6.9)	204 (7.1)	
Self-rated mental health				< .001
Poor	1978 (44.9)	<u>2697 (31.1)</u>	1205 (41.7)	
Fair	1582 (35.9)	3327 (38.3)	1038 (36.0)	
Good	<u>422 (9.6)</u>	1444 (16.6)	<u>339 (11.7)</u>	
Very good	<u>68 (1.5)</u>	432 (5.0)	79 (2.7)	
Excellent	<u>9 (0.2)</u>	135 (1.6)	18 (0.6)	
Missing	348 (7.9)	644 (7.4)	208 (7.2)	
K10 ^a numeric score				
<i>M</i> (<i>SD</i>)	33.2 (7.6)	30.1 (8.8)	32.5 (8.4)	Group 1 vs 2 < .001 Group 1 vs 3 < .01 Group 2 vs 3 < .001
Missing	429 (9.7)	882 (10.2)	293 (10.2)	
K10 score categories				<.001
10–15	<u>56 (1.3)</u>	484 (5.6)	87 (3.0)	
16–21	<u>255 (5.8)</u>	1019 (11.7)	<u>224 (7.8)</u>	
22–29	<u>882 (20.0)</u>	2021 (23.3)	<u>553 (19.2)</u>	
30–50	2785 (63.2)	<u>4273 (49.2)</u>	1730 (59.9)	
Missing	429 (9.7)	882 (10.2)	293 (10.2)	

Note. Bold values indicate percentages that were significantly higher than expected.

Underlined values indicate percentages that were significantly lower than expected.

^a K10 refers to the Kessler Psychological Distress Scale, where 10–15 = low level of psychological distress; 16–21 = moderate level of psychological distress; 22–29 = high level of psychological distress; 30–50: very high level of psychological distress.^{159,164}

As shown in Table 7, the reasons to visit Foundry services were also different across the groups. The majority of Group 1 (virtual) visits (68.5%) included youth seeking help for their feelings including stress, anxiety, and depression, compared to 49.1% in Group 2 (in-person) and 54.6% in Group 3 (hybrid). For youth seeking sexual health services, youth in Group 2 (in-person) had the highest percentage (16.9%), compared to 1.0% of the virtual only group and 9.8% of the hybrid group. Similar differences were also observed for youth seeking physical health services: 4.7% in the physical group youth were seeking physical health services compared to 1.4% of the virtual group and 6.1% of the hybrid group.

Table 7

Service Access Description of Study Cohort by Group

Reason for visit (response to: “Today I am here to discuss ...”)	Group 1 (virtual) <i>n</i> = 4407 <i>n</i> (%)	Group 2 (in person) <i>n</i> = 8679 <i>n</i> (%)	Group 3 (hybrid) <i>n</i> = 2887 <i>n</i> (%)

Alcohol/drugs	<u>46 (1.0)</u>	180 (2.1)	51 (1.8)
Eating/nutrition	60 (1.4)	91 (1.1)	29 (1.0)
Family	116 (2.6)	227 (2.6)	63 (2.2)
Finances	23 (0.5)	56 (0.7)	15 (0.5)
Housing	<u>13 (0.3)</u>	75 (0.9)	14 (0.5)
My feelings (stress, anxiety, depression)	3019 (68.5)	<u>4257 (49.1)</u>	1577 (54.6)
Physical health	<u>63 (1.4)</u>	407 (4.7)	176 (6.1)
Relationships	193 (4.4)	<u>200 (2.3)</u>	57 (2.0)
School/work	79 (1.8)	176 (2.0)	47 (1.6)
Sexual health	<u>46 (1.0)</u>	1468 (16.9)	283 (9.8)
Other (please specify)	387 (8.8)	825 (9.5)	361 (12.5)
Missing	362 (8.2)	717 (8.3)	214 (7.4)

Note. Bold values indicate percentages that were significantly higher than expected.

Underlined values indicate percentages that were significantly lower than expected.

Service Utilization

To address the previous research questions on the demographic and clinical characteristics across groups, we focused on the youth who had either fully or partially completed the surveys. For the second research question, which examined overall service utilization patterns, we analyzed service utilization data reported across the entire cohort. Among the youth who reported demographic data, 35.2% did not complete a visit. In contrast, among those who did not report demographic data, 12.1% did not complete a visit. In total, 25.9% ($n = 10,645$) out of 41,034 youth registered with Foundry, but did not complete any service visits (Figure 6).

Overall, 218,513 visits took place across the study cohort, with 25,653 visits (11.7% of total) for Group I (virtual total), 80,081 visits (36.6%) for Group II (in-person total), and 112,779 visits (51.6%) for Group III (hybrid total). Visit counts of each type of service accessed and number of unique youths who accessed each type of service are presented in Tables 8 and 9. Most visits delivered were mental health (Group I: 38.0%, Group II: 22.9%, Group III: 30.9%) and walk-in counselling (Group I: 27.3%, Group II: 17.9%, Group III: 11.0%) services for all groups, matching visited by most youth (Table 5). This was followed by physical health (11.4% of all visits) and sexual health (7.9% of all visits).

As seen in Table 8, sexual health visits accounted for only 1.0% of visits in the virtual group but 12.8% in the physical group and 6.1% in the hybrid group. Similarly, physical health visits made up 5.8% of visits in the virtual group, 8.5% in the physical group, and 14.8% in the hybrid group. A higher percentage of group services was seen for in person (13.3%) compared to virtual (4.3%) and hybrid (7.4%).

As shown in Table 9, the hybrid group overall had the highest repeated visit rate (67.9%) compared to virtual (35.4%) and in-person (40.5%) except for “Groups” and “Indigenous health and wellness” services. Among all provided services, the Foundry work and education program (50.0%), gender affirming care (63.9%) and groups (62.6%) had the highest repeated visit rate.

Table 8*Visit Counts by Type of Service Accessed*

Service	Group I (virtual) <i>n</i> = 6889 <i>n</i> (%)	Group II (in person) <i>n</i> = 17156 <i>n</i> (%)	Group III (hybrid) <i>n</i> = 6344 <i>n</i> (%)	Total <i>n</i> (%)
Sexual health	246 (1.0)	10214 (12.8)	6822 (6.1)	17282 (7.9)
Physical health	1482 (5.8)	6767 (8.5)	16685 (14.8)	24934 (11.4)
Mental health	9758 (38.0)	18300 (22.9)	34824 (30.9)	62882 (28.8)
Substance use	531 (2.1)	2398 (3.0)	8192 (7.3)	11121 (5.1)
Gender care	445 (1.7)	1780 (2.2)	4696 (4.2)	6921 (3.2)
Walk-in counselling	6996 (27.3)	14294 (17.9)	12422 (11.0)	33712 (15.4)
Social services ^a	226 (0.9)	3387 (4.2)	3357 (3.0)	6970 (3.2)
Peer support	2896 (11.3)	6981 (8.7)	5341 (4.7)	15218 (7.0)
Navigation ^b	902 (3.5)	1945 (2.4)	5014 (4.5)	7861 (3.6)
Groups ^c	1112 (4.3)	10641 (13.3)	8304 (7.4)	20057 (9.2)
Foundry work and education	946 (3.7)	1697 (2.1)	5034 (4.5)	7677 (3.5)
Engagement ^d	113 (0.4)	1646 (2.1)	2070 (1.8)	3829 (1.8)
Indigenous health and wellness	0 (0.0)	31 (0.0)	18 (0.0)	49 (0.02)
Total	25653 (11.7)	80081 (36.7)	112779 (51.6)	218513 (100)

Note. Percentages were calculated by dividing the number of visits for each service type by the total visit count for the entire group.

^a Social services: Includes any services that are not health services such as housing, education, employment, etc.

^b Navigation: Includes any service to support the navigation of health and wellness

services in a youth's community.

^c Group: Includes any group led by integrated youth services staff with two or more participants.

^d Engagement: Includes any initial visit to a centre to learn about what is available.

The number of newly registered youth on the Foundry BC platform is a key indicator of service utilization over time. Figure 7 presents the new registration numbers during study period for both Foundry Virtual BC and all physical centres combined. With more physical centres gradually opening since the start of the study period, the increase in newly registered youth has been steady. Foundry Virtual BC has consistently seen new registrations each month; the discrepancy between in person and virtual registrations has increased starting early 2023, potentially due to more centres opening across the Foundry network.

Figure 7

Foundry Virtual BC New Registrations (Orange) and In-Person Registrations Between April 2020 and November 2023

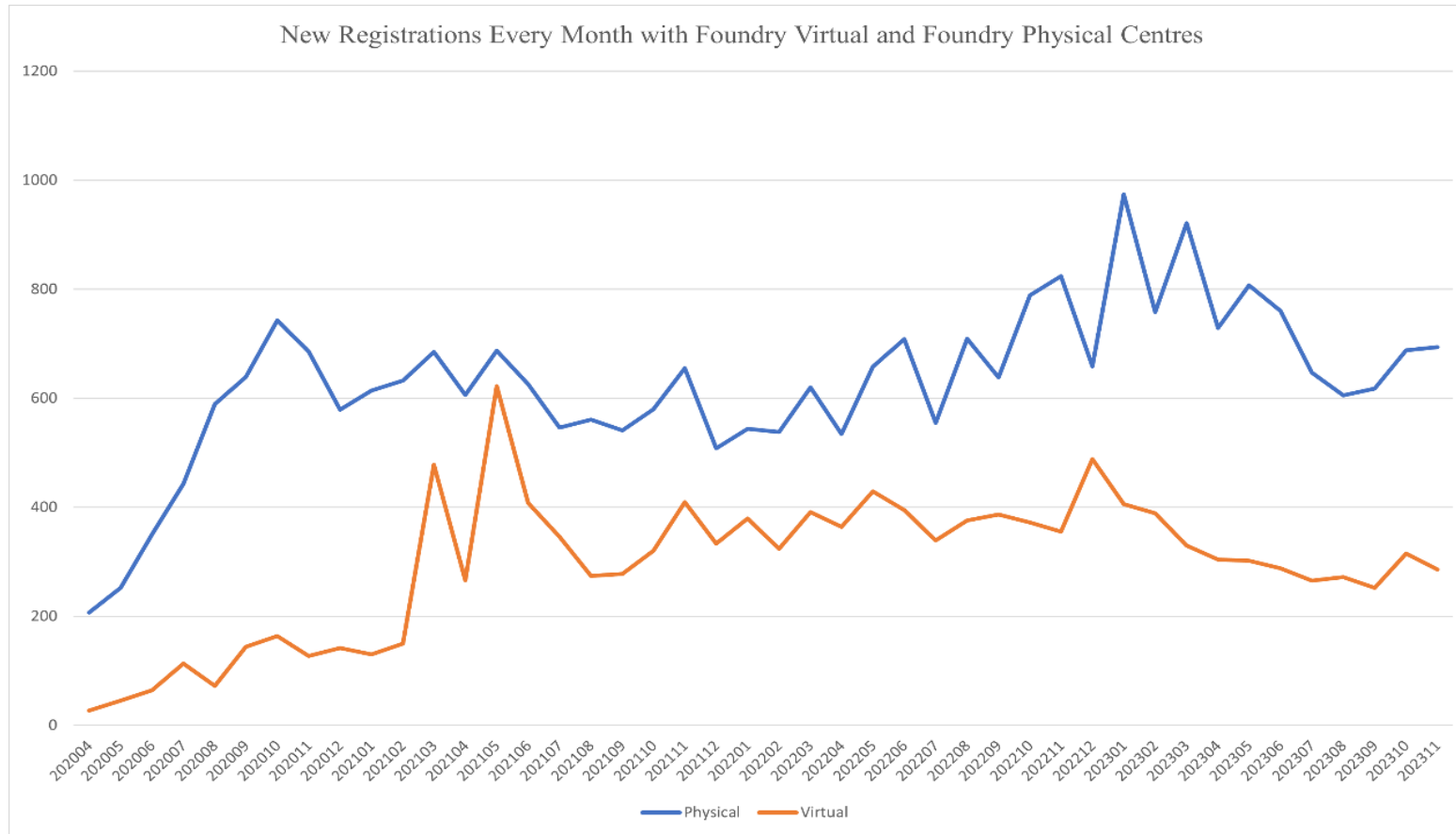


Table 9 *Number of Youth Accessing Each Type of Service*

Service	Group I (virtual) <i>n</i> _I = 6889			Group II (in person) <i>n</i> _{II} = 17156			Group III (hybrid) <i>n</i> _{III} = 6344			Total	Total repeated	Repeat visits %
	≥ 1 visits <i>n</i>	> 1 visits <i>n</i>	repeat visits %	≥ 1 visits <i>n</i>	> 1 visits <i>n</i>	repeat visits %	≥ 1 visits <i>n</i>	> 1 visits <i>n</i>	repeat visits %			
Sexual health	195	34	17.4	4786	2102	43.9	1970	1363	69.2	6951	3499	50.3
Physical health	521	229	44.0	3456	1305	37.8	3155	2398	76.0	7132	3932	55.1
Mental health	3220	1397	43.4	6687	3026	45.3	4529	3654	80.7	14436	8077	56.0
Substance use	264	83	31.4	918	353	38.5	1190	744	62.5	2372	1180	49.8
Gender care	164	83	50.6	600	295	49.2	702	558	79.5	1466	936	63.9
Walk-in counselling	3858	1119	29.0	7027	2478	35.3	3523	2054	58.3	14408	5651	39.2
Social services	150	31	20.7	881	324	36.8	671	369	55.0	1702	724	42.5
Peer support	955	375	39.3	2306	867	37.6	940	510	54.3	4201	1752	41.7
Navigation	766	95	12.4	1258	253	20.1	1729	841	48.6	3753	1189	31.7
Groups	272	199	73.2	2118	1228	58.0	731	527	72.1	3121	1954	62.6
Foundry Works and Education	110	90	81.8	365	260	71.2	474	409	86.3	949	759	80.0
Engagement	97	11	11.3	988	213	21.6	450	196	43.6	1535	420	27.4
Indigenous health and wellness	0	0	NA	18	5	27.8	12	< 5	25.0	30	8	26.7
Total	10572	3746	35.43	31408	12709	40.46	20076	13626	67.87	62056	30081	48.47

Note. Youth could make multiple visits and access multiple services in each visit. ≥ 1 visits = number of youth who accessed the service at least once. > 1 visits = number of youths who accessed the service two or more times (repeated visits).

4.4 Discussion

This study offers a unique perspective examining three distinct service preference groups across 16 physical centres and a virtual service through a provincial IYS initiative. Overall, 25.9% out of 41,034 youth registered with Foundry did not complete any service visits. A quarter of the youth across all three groups (25.3%) stated that they would have gone nowhere if this IYS did not exist. Youth who were younger (aged 12–17) were more likely to access services in person, compared to older youth (aged 18–24) who accessed virtual services more.

Youth who self-identified outside the gender binary were more likely to access virtual services only. Youth who accessed virtual services reported higher distress scores and poorer general health and mental health status than other groups. Despite the provincial virtual service being implemented to support the COVID-19 pandemic crisis, youth continued to access it throughout the study period, which lasted until November 2023. Most youth accessed in-person services ($n = 17,156$, 41.8%), contributing 36.6% ($n = 80,081$) of all visits. Fewer youth used virtual-only services ($n = 6,889$, 16.8%), accounting for just 11.7% ($n = 25,653$) of all visits. Although only 15.5% of youth accessed both virtual and in-person services, they contributed more than half ($n = 112,779$, 51.6%) of all visits. The hybrid group demonstrated the highest level of repeated visits rate (67.9%).

This study provides valuable insights into the demographics of individuals utilizing these IYS services; however, it does not adequately address the motivations of those who did not respond favourably to care. It is crucial for future research and quality improvement efforts to identify the barriers present in the current IYS model that may impede access for specific demographic groups. Additionally, understanding factors that facilitate engagement among youth who are more inclined to seek care is essential. Recent literature suggests that youth with severe MHSU needs tend to attend fewer therapeutic sessions than those with less severe needs when seeking assistance, indicating a potential area for further investigation and intervention.^{153,165} This concern persists in virtual IYS settings, and decision makers need to clarify the barriers preventing youth from fully engaging. Our study did show that youth use the different service modality options, and this choice may be driven by the type of service needed or the unique needs of the youth (e.g., geographical location, physical and sexual health needs).

We also found that youth in the hybrid group were twice as likely to attend repeated visits compared to youth who exclusively accessed virtual or in-person services. Repeated visits can represent conflicting messages in health care services. For example, repeated consultations represent a significant burden on health care services, especially in primary care settings.¹⁶⁶ However, repeated consultations can also serve as feasible intervention for long-term and continuous support for patients throughout their need for

care.¹⁶⁷ Future research should be conducted with both youth and service providers to understand why people do or do not access IYS and what may encourage a young person to have repeated visits over time.

The results of this study indicate the consistent use of IYS virtual and hybrid options over the study period. Although increasing evidence suggests that virtual care may be a valuable option for delivering MHSU services to youth and other populations,¹⁶⁸⁻¹⁷⁰ there is also evidence that the lifespan of virtual care and app-based technologies is often poor.¹⁷ Foundry Virtual BC, including the Foundry BC app, which is integrated into the Foundry network of support, demonstrated consistent uptake among youth across the province. As physical centres continue to expand across various communities in BC, there are steady increases in the total number of registered youth each month. Continued optimal assessment, positive user experiences, and youth persistence in achieving their health goals are considered crucial factors in the decision to use the service.¹⁷¹ Therefore, regular updates and check-ins could help youth remain engaged with services that are both acceptable and accessible to them. Determining the most effective way to sustain the service meaningfully is crucial for future research and quality improvement efforts due to the high resource costs and the varying levels of acceptance among different end-users associated with virtual services.¹⁷²

IYS are emerging to support equitable access for youth to the range of services they need when they need them.¹⁶ Canadian and international teams are making progress to centre youth engagement and service access through evidence- and measurement-based care while transforming fragmented care into a more integrated system.^{155,156,173,174} Although online services have been discussed in other IYS settings,^{173,175} there is limited evidence exploring virtual care access barriers and utilization patterns within an IYS initiative. Previous studies identified time, transportation, and financial constraints along with long wait times and lack of awareness as key barriers to youth accessing health services.¹⁷⁶ Foundry provides free and confidential youth health services, which addresses financial concerns; its IYS nature ensures that services can be accessed at a single point to help mitigate time and transportation concerns. The introduction of virtual services provides a potential new service option that helps remove structural barriers, particularly for those seeking MHSU care. However, a quarter of all registered youth ($n = 10,645$, 25.9%) still did not proceed to accessing services (see Figure 6). Future exploration for reasons why is warranted.

This research indicates a pressing need for further investigation into the underlying mechanisms connecting youth with their service preferences. A key area of future research should be the development and implementation of upstream accessible virtual intervention options. Such interventions may be particularly beneficial for

engaging youth who exclusively prefer online support, thereby potentially mitigating the progression to more severe MHSU conditions. Notably, approximately 10% of registered youth in this study reported not holding Canadian citizenship or permanent residency, highlighting a demographic that may require targeted outreach and tailored interventions. Future research could use multiple methods to explore how all types of IYS are meeting youths' cultural needs. As well, more research is needed to understand the impact of care in all three modalities (virtual, in-person, and hybrid) over time, including addressing the “quintuple aims of health care improvement”^{177,178} by improving (a) population health outcomes, (b) care experiences of youth and families, (c) cost-effectiveness, (d) well-being of service providers, and (e) health equity.

Limitations

This study has four main limitations. First, the administrative data source included incomplete demographic and clinical information and no way to know if the reluctance to disclose personal and health information correlated with health preferences and statuses. That is, these data may not have been missing at random, which would impact analysis of demographic and health characteristics across the three groups.

Further, the study cohort was youth who accessed Foundry services. Considering the total BC population,¹⁷⁹ youth percentage,¹⁸⁰ and estimated MHSU burden among youth,³ an estimated 150,000 youth are affected by MHSU concerns in BC, but our study

sample was 41,034 youth. Therefore, it is challenging to generalize the study results to the entire youth population, and it is also difficult to gather insights from youth who accessed alternative means of services or had no access to services at all.

Additionally, the health measures at registration were limited to self-reported health and mental health, along with K10 distress scores, thereby presenting a restricted array of psychometric tools or qualitative measures employed to evaluate health status.

Finally, due to the high level of autonomy granted to youth in accessing or discontinuing Foundry services, we lacked repeated and controlled measures of health outcomes tracking each youth from baseline over time. The collection of data over time through repeated measures is critical to understanding the impact of IYS on health outcomes associated with each service mechanism.

4.5 Conclusion

The study results reveal insights into youth utilization patterns of health services within natural settings and highlight the significance of understanding these choices. Decision makers and service providers can use this information to understand the extent to which demographic and clinical differences exist across service types (virtual, in person, and hybrid). Further research is needed to explore the underlying relationship between youth MHSU service preferences and utilization patterns, particularly the impacts of early intervention and outcomes over time. Quality improvement efforts are

also critical to support the continuous evolution of IYS and emerging needs of youth.

Creating culturally safer and inclusive IYS care environments for all youth is critical to promote equity, reduce disparities, and enhance engagement to design and deliver services that are accessible and evidence-based. Although this is the first known IYS study to explore the three service modalities, it is clear that virtual, in-person, and hybrid IYS options are all relevant and responsive to the needs and priorities of the communities they serve. Measuring effectiveness over time will be critical for future policy and quality improvement efforts in BC and beyond.

Chapter 5: Study 3 Qualitative Analysis

Unlocking Mobile Health Adoption: A Qualitative Exploration of User Experiences, Barriers, and Facilitators in Integrated Youth Services in British Columbia, Canada

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Summary

Background. Early onset of mental health disorders is prevalent, yet many cases remain undetected and inadequately treated, emphasizing the critical need for early intervention strategies. In Canada, the youth mental health system faces major challenges, such as fragmentation and limited resources. Integrated youth services (IYS) emerged to address these gaps for youth aged 12–24 years. Additionally, mobile health (mHealth) platforms, such as the Foundry BC platform, have been introduced to enhance access to care, and study is needed to understand how mHealth can be effectively integrated and sustained within an IYS network.

Objective. This study aimed to explore stakeholder perspectives on the development of a sustainable, youth-centred mHealth system to improve mental health outcomes for youth.

We had three research questions: (a) What are the perceptions of mHealth among users, service providers, and nonclinical staff regarding its effectiveness and impact on youth mental health services? (b) What are the perceived barriers and facilitators amongst IYS stakeholders to mHealth integration within the larger Foundry IYS network? and (c) What strategies do stakeholders identify as essential for the sustainability of mHealth services for youth?

Methods. This qualitative study used semi-structured, in-depth interviews with three stakeholder groups within the Foundry network: youth users, service providers, and nonclinical staff. Participants were recruited through social media and snowball sampling. A total of 23 interviews were conducted. We used an inductive approach and thematic analysis to identify and summarize common themes and subthemes.

Results. Participants identified three major themes in their perceptions of mHealth: (a) it is “good on its own,” (b) it can address barriers to in-person services, and (c) it has inherent limitations. Three key themes emerged about perceived barriers and facilitators: (a) mHealth design characteristics, (b) individual factors, and (c) external factors. Across all participants, the sustainability of mHealth services was perceived to be primarily influenced by the quality of the services provided and the level of external support

available.

Conclusion. This study underscores the multifaceted nature of mHealth adoption within an IYS network, revealing critical insights into user perceptions and the barriers and facilitators that shape this process. Participants highlighted the importance of addressing motivations, privacy concerns, and accessibility, making it clear that a careful approach is essential for fostering sustainable integration of mHealth solutions. Future research should prioritize the experiences of youth groups who are traditionally not very vocal and explore the potential of co-design in enhancing mHealth development. Doing so could ensure that mHealth not only meets the diverse needs of youth, but also contributes to more equitable health outcomes in the long term.

5.1 Background

Recent reports from the World Health Organization (WHO) and Lancet Psychiatry indicated that the peak onset for most mental health disorders occurs around 14.5 years of age.^{181,182} This onset underscores the urgent need for early intervention, as it significantly influences educational achievements, functional capacity, and social roles throughout adulthood.¹⁸³ Given the profound impact of mental health during this transition to adulthood, there is an immediate demand for a mental health care system that is not only affordable and effective, but is also developmentally appropriate. In Canada, the mental health system has been critiqued for being fragmented, under-

resourced, and inefficient at meeting the needs of youth.^{33,184–187} Recently, integrated youth services (IYS) have emerged as a novel solution by creating a single access point for different services addressing mental health and substance use (MHSU), physical and sexual health, peer support, and social services (e.g., housing, education, and employment support). Establishing IYS in a community requires a comprehensive strategy that emphasizes co-design with youth and families, coordinated service implementation, and youth-centred evaluation processes.¹⁴

In 2020, the COVID-19 pandemic marked an important period to reimagine how health care services could be delivered using mobile health (mHealth) modalities. In IYS in British Columbia (BC) mHealth services were quickly designed, developed, and implemented to provide app-based and virtual care services to youth across communities. Before the pandemic, evidence demonstrated that mHealth was a powerful modality for psychoeducation,^{188,189} self-management,^{190,191} and generally improving health outcomes.^{17,192} However, most studies demonstrated limited sustainability of mHealth interventions or services.¹¹

Studies published during the pandemic have also shown the feasibility of transitioning in-person health care services to remote services with high effectiveness and positive feedback.^{116,142,193} However, for youth specifically, there is a notable concern that mHealth technologies and interventions are highly unregulated and vary significantly

in terms of evidence level, measurement tools, delivery methods, and evaluation standards.¹⁷ Additionally, there is limited evidence on the user experience of youth mHealth services within youth MHSU settings, including IYS. More information is needed to understand how mHealth is integrated as a core part of an IYS system of care. This information includes the critical perspectives of those who use it to receive care (youth), those who provide care (service providers), and those who organize systems of care delivery (nonclinical staff).

Mobile Health Adoption in a Youth-Centred IYS: Foundry

Starting in 2015, a province-wide IYS initiative called Foundry was developed, implemented, and scaled up to improve access to care for youth in BC.¹⁹⁴ In April 2020, Foundry launched its virtual service, the Foundry BC platform, which enables youth to access online health resources; schedule appointments with service providers; and to communicate through chat, audio calls, or video calls. This mHealth service continues to be a vital component of the Foundry delivery model 4 years later, particularly for youth living in areas without a physical Foundry centre.

Between 2018 and 2023, Foundry provided services to over 41,000 unique youth through both virtual and in-person options. In a recent descriptive study led by our team, we found that more than one third of these youth reported they would not have sought help elsewhere if not for the services offered by Foundry.¹⁹⁵ Among those who did

receive care, 60% used in-person services only, 20% accessed only virtual care, and 20% accessed both types of service. Notably, youth who relied solely on mHealth services were more likely to seek help for stress, anxiety, and depression than those in other groups. Additionally, older youth and those with poorer mental health were more inclined to use mHealth services than those accessing in-person care. The study also found that the rate of repeated visits was significantly lower among youth who used only virtual services compared to those who accessed in-person services or both service types.¹⁹⁵

At this pivotal stage in mHealth implementation, there is a need to gain deeper insights into the integration and sustainability of mHealth within the IYS model. The primary aim of this study is to capture the perspectives of youth and key mHealth stakeholders on how to create and implement a youth-centred, sustainable mHealth solution that enhances mental health outcomes and experiences over time. Three key questions guided our exploration:

Research Q1: What are the perceptions of mHealth among users, service providers, and nonclinical staff regarding its impact on youth mental health services?

Research Q2: What are the perceived barriers and facilitators among IYS stakeholders to mHealth integration within the larger Foundry IYS network?

Research Q3: What strategies do stakeholders identify as essential for the sustainability of mHealth services for youth in BC?

5.2 Methods

5.2.1 Study Design

This study used an inductive qualitative approach with semi-structured, in-depth interviews with three priority participant groups within the Foundry network: youth, service providers, and nonclinical staff.

This study adopts an interpretivism-oriented ontological approach, which focuses more on how people feel, perceive and experience of the reality around them. Rather than viewing youth mental health and mHealth adoption as objective, fixed realities, this study recognizes that stakeholders (youth, service providers, and nonclinical staff) interpret and experience these concepts differently based on their unique contexts and lived experiences. Consequently, the findings are not seeking a singular "truth" but instead reflect multiple, co-existing perspectives on the integration of mHealth services.

This study aligns with interpretivist epistemology, emphasizing that knowledge is co-constructed between the researcher and participants through dialogue and reflexive engagement. Given that the study explores perceptions, barriers, and facilitators of mHealth adoption, the research process acknowledges the subjective and context-dependent nature of knowledge. Building upon this reflexive approach, the researcher's own positionality confronts and questions who we are as researchers and how this guides our work. This reflexivity process to examine my own assumption, belief, and judgement

systems, and think carefully about how they influence the research process and results is also integral to meaning-making, shaping how data is interpreted rather than merely "discovered."

For my own positionality, my experience in lower-resourced settings allows me to recognize the dual nature of mHealth and its context-based impact. This perspective shaped my data interpretation, acknowledging that certain factors can act as both facilitators and barriers. Additionally, my multicultural background informs my understanding of the need for integrated and more importantly, localized youth services. Lastly, coming from a more conservative Asian cultural background and more introvert personality myself, I emphasize the importance of amplifying youth voices throughout the mHealth service process.

Ethical approval was received from the University of British Columbia Office of Research Ethics Behavioural Research Ethics Board (#H22-03454). Study findings are reported aligned with the COREQ (COnsolidated criteria for REporting Qualitative research) checklist for qualitative studies.

5.2.2 Study Sample

Youth Users of Foundry App. The inclusion criteria for youth included those who were between the ages of 16 and 24 (youth aged 15 and under were excluded due to

the need for obtaining parental consent), were able to communicate in English, and had used the Foundry BC Platform to access services in the past year. Youth were recruited from recurring social media posts from January 2024 to May 2024 (see flyer Appendix B, identifying information removed). These posts included a brief introduction to the study and outlined what to expect during an estimated 1-hour interview. To ensure a diverse range of experiences, we did not impose restrictions on the frequency or purpose of mHealth usage.

Service Providers. For this group, we recruited IYS service providers (e.g., counsellors, social workers, primary care providers) who had used mHealth to deliver care (e.g., virtual youth counselling, remote info sessions, online peer support groups). Most service providers were purposively recruited from Foundry Virtual and Foundry Richmond, as Foundry Richmond was the first physical centre to fully integrate the Foundry BC platform into its clinical service workflows. We also used snowball sampling¹⁹⁷ to recruit service providers across the two recruitment pools.

Nonclinical Foundry App Staff. For this group, we recruited technology and implementation experts who were engaged in the design, development, and implementation stages of the Foundry BC platform. Upon receiving ethical approval, we reached out to the Foundry communications team to share information about the study opportunity to qualified mHealth nonclinical staff who met the inclusion criteria. This

process was used to ensure confidentiality of staff so they could make an unbiased decision to participate in the interviews.

5.2.3 Data Collection

We constructed open-ended questions based on a previous literature review and descriptive analyses of Foundry's virtual service utilization patterns.¹⁹⁵ The technology acceptance model (TAM),^{68,70,71} which explains how users come to accept and use technology. This model posits that a person's intention to use technology depends on its perceived usefulness and ease of use. Therefore, TAM guided my choice of questions on mHealth usability. The semi-structured interview format allowed participants to elaborate on topics of interest beyond the interview guide (Appendix C), focusing on three major areas: perceptions of the mHealth concept, user experiences with the Foundry BC platform, and sustainability in mHealth services.

We recorded and transcribed all interviews, taking notes during the sessions to aid later data cleaning processes. We conducted interviews until data saturation was reached.

5.2.4 Data Analysis

Following Clarke and Braun's six-step guide,¹⁹⁸ we conducted a reflexive thematic analysis to analyze the qualitative data from the interviews with the three stakeholder groups. We used an inductive approach to identify and summarize common categories to address all three research questions.¹⁹⁹ The lead (XD) and senior author

(SB) transcribed and read all interviews to familiarize themselves with the data while taking note of preliminary ideas and codes. Codes were organized into potential themes, collating all relevant data under broader thematic categories. Researchers XD and SB independently reviewed the themes using an iterative approach to ensure they reflected both the coded data and the overall content of the data set.

To enhance the trustworthiness and rigor of the study, we incorporated several strategies. First, we incorporated multiple perspectives in the process, both XD and SB independently reviewed transcripts, codes, and themes, followed by team discussions to resolve discrepancies and enhance credibility. We also multiple data sources by including diverse stakeholder perspectives (youth, service providers, and non-clinical staff) in the dataset, allowing the research team to compare and contrast viewpoints across the three groups. This nuanced process was important to help our team integrate the diverse insights from the various stakeholders.

The lead author XD maintained a reflexive journal throughout the data collection and analysis process to document evolving assumptions, biases, and reflections throughout, which were regularly discussed with the senior author SB to promote reflexivity and limit researcher bias. The team engaged other co-author (KM) during data analysis to challenge interpretations during regular meetings, where emerging findings, analytic decisions, and potential blind spots were critically discussed. Regarding data

saturation, we determined that no new themes were emerging after the final set of interviews across the three stakeholder groups. Our judgment of saturation was based on repeated patterns in the data, consistent codes, and team consensus that additional interviews were unlikely to generate brand new insights. Additionally, we conducted a member-checking exercise by inviting two youth participants, who had expressed interest in staying engaged with the project during their interviews, to review a summary of the preliminary findings. Both participants provided feedback in follow-up sessions, verified and confirmed that the identified themes resonated with their understanding and experiences. They also highlighted some minor clarifications, which were incorporated into the final analysis. This process added rigor and contributed to the confirmability of the findings.

After identifying themes for each research question, the authors discussed and selected the most representative examples from the transcripts for each theme, presenting in-depth quotes alongside the group name and a pseudonym for each participant. To better reflect the experiences of patients and providers, we displayed all information in tables, labelling each key theme according to its frequency of mention by three participant groups: youth, clinical service providers, and nonclinical staff. After themes were identified inductively, researchers incorporated technique from content analysis and classified frequency of theme mentioned by each stakeholder group as follows: +++ for

the most frequently mentioned themes, ++ for frequently mentioned themes, + for themes mentioned occasionally, and - for themes not mentioned by that group. Finally, we carefully examined the identified themes to detect similarities, differences, and relationships horizontally across the three mHealth stakeholder group, and vertically across three research questions.

5.3 Results

5.3.1 Participants

We conducted a total of 23 participant interviews.

Youth users. Sociodemographic characteristics (age, gender, ethnicity) along with basic mHealth utilization characteristics (frequency and the main purpose of using mHealth) were collected during the interview in an open-ended way without any predetermined choices nor categories. A total of 12 youth were interviewed and their descriptions are presented in Table 10. Youth users ($n = 12$) were of a median age of 20 (range 18–24). Most reported using mHealth mainly to access online articles and peer recovery stories ($n = 7$), and some ($n = 6$) used mHealth to book appointments for in-person and virtual sessions at Foundry.

Clinical Service Providers and Nonclinical Staff. We interviewed six clinical service providers and five nonclinical mHealth staff, whose profiles are detailed in Tables 2 and 3. The service providers ($n = 6$) had a median age of 33.5 years, with ages ranging

from 23.0 to 45.0. On average, they had 4.2 years of experience in the health field, with a range of 1.5 to 7.0 years. The nonclinical staff ($n = 5$) had a group a median age of 34, with ages spanning from 29 to 46. Their average experience in the health sector was 14.1 years, ranging from 8.0 to 23.5 years.

Table 10

Description of Youth Demographics (N = 12)

Characteristic	Amount
Age	
<i>M</i> , median (range)	20.4, 20 (18–24)
Self-reported gender (<i>n</i> , %)	
Female	10 (83.3)
Male	2 (16.7)
Frequency of mHealth use (<i>n</i> , %)	
Once a week	3 (25.0)
Once every 2 weeks	1 (8.3)
Once every few months	1 (8.3)
Whenever needed	5 (41.7)
Not sure/not reported	2 (16.7)
Main purpose of mHealth use ^b (<i>n</i>)	
Make appointments with service providers	4
Attend online sessions	3
Reading articles and stories	7

^a We used the original answers from youth without categorizing them.

^b Each youth could report more than one main purpose.

Table 11*Description of Clinical Service Providers and Nonclinical Staff*

Characteristic	Clinical service providers <i>n</i> = 6	Nonclinical staff <i>n</i> = 5
Age		
<i>M</i> , median (range)	32.8, 33.5 (23.0–45.0)	35.6, 34 (29–46)
Self-reported gender: <i>n</i> (%)		
Female	4 (66.7)	3 (60)
Male	1 (16.7)	1 (20)
Nonbinary	1 (16.7)	1 (20)
Place of work:* <i>n</i> (%)		
Foundry Richmond	5 (83.3)	-
Foundry Central Office	-	4 (80)
Foundry Virtual	1 (16.7)	1 (20)
Years of experience		
<i>M</i> (<i>SD</i>), median (range)	4.2 (2.2), 4.3 (1.5–7.0)	14.1 (5.8), 12.0 (8.0–23.5)
Years with Foundry		
<i>M</i> (<i>SD</i>), median (range)	2.5 (1.0), 2.3 (1.5–4.0)	3.4 (1.1), 3 (2–5)

*Different in-person and online locations with the Foundry IYS network.

5.3.2 RQ 1: How do stakeholders perceive the concept of “mHealth”?

In total, three main themes were identified to answer this research question. A complete list of themes with the frequency of mentioning from three groups is presented in Table 12.

Table 12*Stakeholder Perceptions of the mHealth Concept*

Theme	Subthemes	FY	FC	FNC
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“Good on its own”	Easy to access	+++	+++	+++
	Easy scheduling	+	++	+
	Power of being in control	+	+	+++
	One stop for all resources	+	+	+
Solutions to current barriers	Physical limitation	+++	+++	+
	Time limitation	++	++	+
	Fear of attending in-person session	+++	+++	+++
Limitations of mHealth	Lack of personal connection	+++	++	+
	Limited capacity	++	++	++
	Technology anxiety	++	+	+++

Note. FY = frequency of mentions by youth; FC = frequency of mentions by clinical service providers; FNC = frequency of mentions by nonclinical staff; +++ = very frequently mentioned by most participants; ++ = frequently mentioned by around half of participants; + = occasionally mentioned by one or two participants.

Theme 1: “Good on its own.” Participants identified that the most important aspects of mHealth at Foundry were: (a) ease of access, (b) ease of scheduling, (c) youth being in control of health care choices, and (d) a one-stop-shop for all health resources. All three participant groups agreed the greatest strengths of mHealth services within the IYS network were the enhanced accessibility of health and wellness services and the platform's flexibility in scheduling and connecting to various resources, including service providers and educational materials. Participants highlighted the empowering effect of mHealth on youth, noting that control over modalities fosters effective two-way communication and boosts their confidence in seeking services. This sentiment

underscored the importance of mHealth in addressing the anxieties of youth and facilitating their engagement in care.

“Youth who are going through lived experience need the power, and they need that choice because most of the time they don't feel like in control of their lives”

(Allison, nonclinical staff.)

Participants discussed how the mHealth platform empowered youth by allowing them to choose their preferred providers, select the type of information they wanted to access, and decide when to access services or information. For service providers, participants noted that the flexibility gave them greater control over their work schedules and performance.

You could feel better about the job and feel better about your work and actually be there for your clients because you're just in a better head, space yourself. Your work-life balance is better. Being able to work from home feels more sustainable to me. (Jacob, clinical service provider.)

Last, participants emphasized that mHealth's ability to centralize available resources into a single access point was crucial. Youths noted that they especially valued this feature, as it eliminated the need to visit multiple locations for different services and prevented them from having to repeatedly share their personal stories with various service providers. Although all participant groups mentioned this aspect, the youth

provided the most detailed insights into its significance, highlighting how it streamlined their access to care and enhanced their overall experience.

I think the idea is just being able to have an access point for those who are unhealthy for whatever fits their needs. Just being able to actually access it, and then just be like a one stop shop to have those resources for those who can't go to all the places they need to be. (Rachel, youth)

Theme 2: Solution to Existing Barriers. The second theme related to participants' perceptions of how mHealth could be used to overcome barriers encountered when accessing in-person services. Within this theme, 3 subthemes were identified.

For the first subtheme, most participants mentioned the challenge of the physical location of centres that caused the inability to access health. Participants highlighted transportation issues, with youth like Emily stating, *“There is no center nearby, so I had to find a bus or beg someone to drive me.”* All three groups articulated that mHealth serves as a vital solution for young individuals who are unable to leave their homes due to factors such as exhaustion, chronic illnesses, and physical disabilities. Participants also indicated that mHealth effectively mitigates both invisible barriers, such as fatigue, and tangible physical barriers that impede mobility, thus enhancing access to care for vulnerable youth populations.

They are not allowed to leave the house because strict parents or have chronic illness chronic pain make it really difficult for them to get out. (Olivia, clinical service provider)

As a second subtheme, participants reported that mHealth could help both youth and service providers to solve time-related challenges, such as inaccessible centre hours, no time to travel, and the long wait time to see therapists. Long wait times for drop-in services at Foundry sites was also a significant time-related barrier. As Olivia, a clinical service provider, noted, *“There's a lot of issues for drop-in, especially with the wait times. People often find themselves waiting for a drop-in at a Foundry site, for in-person, and it takes up a really big part of their visit time.”* This highlights how traditional in-person services can be time-consuming, reinforcing the need for mHealth solutions that offer more accessible and efficient alternatives. Describing this subtheme, participants emphasized the importance of the flexibility that mHealth offered to access services that were fit for purpose and met families' needs.

The third subtheme, “fear of attending in-person sessions,” was strongly emphasized by all three participant groups. Many participants reported that youth often experienced social anxiety or stigma associated with accessing in-person appointments. As one nonclinical staff, Sarah, noted, *“It is a distressed place. Everything feels so overwhelming, and they're just looking for a simple, easy pathway.”* Participants

identified mHealth as a valuable tool for alleviating the pressure of interacting with service providers and facilitating communication while maintaining a degree of anonymity. Additionally, a unique perspective raised exclusively by youth was the concern regarding the physical location of centres, which they sometimes described as being situated in “sketchy” neighborhoods. Consequently, even when transportation was not a significant barrier, some youth expressed a reluctance to visit in person, opting for mHealth as a safer and more comfortable alternative.

I think what's happening is, and we have a lot of service providers, think this as well is that these young people are getting scared and they're going, Wait! I don't want to see anybody! I don't want to talk to anybody! (Alison, nonclinical staff)

Theme 3: Limitations of mHealth. The third theme identified by participants was their awareness of the inherent limitations of mHealth. Although participants reported many benefits of mHealth, they reported that it was not a complete replacement for high quality evidence-based in-person services. Participants reported mHealth to be an adjunct to in-person services and unique in its potential and limitations. “I think that it can't fully replace it. But it can add on to it. it could be a 50-50” (Emily, youth). In addition to the overall impressions provided, three subthemes were revealed by the data.

In the first subtheme, participants noted the importance of the personal connections developed during in person. Youth strongly emphasized that they were often

seeking a personal connection when accessing services, and that this was very difficult in a virtual environment. Youth noted the experience online was different than the supportive experience they may receive in a physical centre. *“Talk to a peer support worker at the front desk. They can just strike up a conversation, or there might be candy on the table, and oh, that's so nice”* (Kate, youth).

The second subtheme was the participants' perception of mHealth's limited capacity to provide services to address the full range of needs that youth ask for, such as primary care, sexual health, and physical health. Participants reported that centres had a natural flow to service access and referrals, and particularly clinical service providers reported that there were often more distractions when using mHealth, such as someone walking in to a session or a cat scratching at the door. Some participants discussed their worries about the organic nature of in-person relationship building getting lost.

Youth and clinicians reported significant challenges using art-based modalities or silence during online treatment sessions. Some clinical service providers said the virtual format often contributed to a sense of personal isolation and loneliness, especially with excessive screen time. They expressed feeling a loss of essential collegial support, opportunities for collaborative learning, and the ability to use the physical environment as a therapeutic tool. This lack of shared, in-person experiences made it harder to create an engaging and supportive therapeutic atmosphere.

“Sometimes I would take the youth for a walk, or sometimes we would use the land, or sometimes I would have like fidget toys in my office. So just not being able to use the like physical stuff virtually” (Grace, clinical service provider).

As Kate, a youth participant, also expressed concerns with the limited capacity of online services, *“Especially for people who might not communicate best verbally. If they want to use sign language or express themselves through body language, clinicians cannot detect their surroundings to support the session effectively.”*

The third subtheme, “technology anxiety” was discussed mostly by Nonclinical staff. This group collectively worried about technology-related challenges like confidentiality, bugs, or simply that “technology is not for everyone” (Alison, nonclinical staff). Youth who reported being engaged extensively with contemporary technologies also expressed concern about technological advancements and the ability of mHealth to keep up. Interestingly, few clinical service providers discussed this as an issue, but most did recognize the importance of expertise and investments to keep the systems operating so that they could provide the best care possible. “Our society have this trend of turning everything to technology online, there is a precaution of like how much is true and what is your actual situation behind screen?” (Rachel, youth).

5.3.3 RQ 2: Perceived Facilitators and Barriers to Integration

To answer Research Question 2, we asked participants to reflect on the barriers and facilitators to mHealth integration at Foundry. Of note, the nonclinical staff who mainly worked with development and implementation strategies reported that they had limited user experience with the Foundry BC Platform itself, so they were asked about their experiences with the youth and clinicians who they worked with. Full lists of main themes and subthemes for barriers and facilitators are presented in Tables 13 and 14.

Table 13

Barriers to mHealth Adoption From User Experience

Theme	Subthemes	FY	FC	FNC
mHealth design characteristics	Scheduling	++	+++	+
	Navigation	+++	+	+
	Reliability and usability	+	+++	+++
Individual factors	Inner struggle	+++	+++	+
	Privacy concern	++	+	+++
	Lack of human interaction	+	+	-
External factors	Lack of safe space	+++	+++	+++
	Technology literacy	+++	++	++
	Language	++	-	-

Note. FY = frequency of mentions by youth; FC = frequency of mentions by clinical service providers; FNC = frequency of mentions by nonclinical staff; +++ = very frequently mentioned by most participants; ++ = frequently mentioned by around half of participants; + = occasionally mentioned by one or two participants.

Table 14*Facilitators for mHealth Adoption From User Experience*

Theme	Subthemes	FY	FC	FNC
mHealth design characteristics	“My story” function	+++	+	+
	Connection tool	+++	++	+
	Content	+++	++	-
Individual factors	Escape in-person burden	++	++	-
	Self-driven motivation	+	+	+
	Privacy concern	+++	+	+
External factors	Support from peers	++	+	-
	Provide safe space	++	+++	+

Note. FY = frequency of mentions by youth; FC = frequency of mentions by clinical service providers; FNC = frequency of mentions by nonclinical staff; +++ = very frequently mentioned by most participants; ++ = frequently mentioned by around half of participants; + = occasionally mentioned by one or two participants.

Perceived Barriers

Theme 1. mHealth Design Characteristics. The first theme, perceived barriers, related to the design characteristics of mHealth, specifically addressing how the product was developed and its functionality. This theme was further delineated into three subthemes.

The first subtheme was scheduling. Youth expressed frustration with the limited availability of appointments on the Foundry BC Platform and the challenges of coordinating sessions with their preferred service providers. Participants noted that

having to repeatedly share their personal stories with different individuals could erode trust, diminishing their motivation and confidence to seek help in the future. Clinical service providers echoed these concerns, reporting that the introduction of a new booking channel through mHealth often resulted in additional scheduling difficulties, creating a sense of frustration.

They can only see 2 weeks ahead. If they were looking for a specific counsellor.

That was maybe booked out. And it is hard to bypass anything on the platform, compared to you directly talk to the counsellor and add sessions to their calendar.

(Kelly, clinical service provider)

The second subtheme was navigation. Participants felt that the redundant registration and login processes posed a threat to the adoption and integration of mHealth services. This issue was brought up repeatedly by youth who expressed concern that younger youth, without their own phone number or email, would not even be able to complete mHealth service registration. Participants indicated that the time required to complete demographic questionnaires, along with the inconvenience of logging in without a saved password option, significantly hindered their willingness to proceed with the mHealth platform. This added burden created unnecessary barriers, deterring users from fully engaging with the services offered.

“You have to log in and deal with all the questions. And I don't know if everyone has a phone number, many other personal information that youth may not know”
(Rice, youth).

The third subtheme was design-related reliability and usability. Participants stated that the app sometimes crashed and this could be extremely frustrating. Nonclinical staff emphasized that this area of ongoing development and product refinement required 24/7 attention, viewing it as a crucial long-term investment to fully optimize and integrate the service. Other usability concerns were discussed as a significant barrier to mHealth adoption, particularly from clinical service providers' perspectives. Although mHealth users preferred the chat option over traditional phone calls for reaching clients, clinical service providers reported difficulties in contacting youth through online tools. Some youth also reported that design characteristics like app's appearance and navigation could also influence service usability.

It is hard to get in touch with clients on the app. You check your ins your texts every day but apparently youth don't check their Foundry app all the time. You need to find a way to sync the notification system and the calendars. (Ying, clinical service provider)

Theme 2. Individual Factors. This main theme highlighted how personal attributes could serve as barriers to the adoption and integration of mHealth solutions,

identifying internal concerns rather than characteristics of the mHealth product itself.

This theme included three subthemes.

The first subtheme emerged from individuals' internal conflicts when seeking help, particularly the challenges they faced fueled by fear and anxiety experienced by youth who were uncertain about what to expect from their upcoming mHealth sessions, as reported by both youth and clinical service providers. *“If they've never accessed the health service, they have the perception like they're gonna ask me really deep questions off the bat. And feel really triggered. They do not know what to expect”* (Lulu, clinical service provider).

The second subtheme pertained to privacy, a significant concern for youth who shared their devices and accounts with family members. As one clinical service provider, Kelly, noted, youth often used shared platforms such as “ iCloud accounts, family teenager accounts, and household phones or desktop computers.” Although parents and caregivers may not actively interfere with their access to services, youth reported that they frequently refrained from seeking care to avoid potential privacy violations. *“For someone who has such lived experiences. It's scary to think that your stories out there. Where is the database? I think that kind of scares me”* (Rachel, youth).

The final subtheme highlighted the absence of human interaction that is inherent in mHealth services. Many youth, particularly those who valued personal connections,

reported that they may have declined to use mHealth, even if it was the only available option. As Emily, a youth, noted, *“It has the personal touch to it. I’m very much a people-oriented person, and I need that personal interaction with people because it can be very beneficial.”* Nonclinical staff also expressed concerns about the increased isolation that could accompany the adoption of mHealth solutions.

Theme 3. External Factors. The third main theme was external barriers to mHealth adoption and integration within IYS. There were three subthemes included. The first and the most prominent external factor identified by all three groups was the lack of a safe space when accessing mHealth services. This concern was multifaceted and encompassed conflicting perspectives, as individuals defined a safe environment differently. Some youth expressed concerns that their homes were not safe places to access mHealth services due to parental involvement and cultural stigmatization of seeking mental health support. Conversely, others stated that their homes were the only safe places for them to have virtual calls without disturbances or bullying at school.

I’m from a Brown family, and we saw mental health being present in our family like “Oh, mental health! you’re fine. Just go take a nap!” It will be a big, big thing if you go to someone ... and get “help,” There’s a lot of stigmas around it for a lot of people. (Sisi, youth).

The second subtheme was technology literacy; the ability to use, manage, understand, and assess technology,²⁰⁰ was also a frequently mentioned barrier by all three groups of stakeholders. Something as seemingly simple as owning a phone or having internet access could become significant obstacles, particularly in rural and remote communities. Beyond access, some participants described more challenges related to technology usage, including limited familiarity with downloading apps from “online stores”, navigating digital platforms, or managing privacy settings.

You first need to own a smartphone; some places don't even have cell service.

Youth need to go to public library. Someone older gen caregivers just call in like the old way, it's impossible to all of a sudden just hey you need to use an app for these. (Flora, clinical service provider)

The final subtheme addressed language barriers. Some youth reported difficulties accessing mHealth services in their native language due to the limited availability of such options online. Although many youth were capable of communicating in English or French (Canada's official languages), they often reported feeling more at ease in sessions conducted in their native language, as this fostered a greater sense of support, connection, and intimacy with the service provider. As one youth, July, articulated, “I speak English, but English is not my first language, and when it comes to expressing myself to the therapist, it gets harder.”

Perceived Facilitators

Theme 1. mHealth Design Characteristics. The first main theme in facilitators for mHealth use was the design characteristics of mHealth platforms. This theme encompassed three subthemes that motivated youth engagement with mHealth services.

First, a majority of youth identified the "My Story" feature as the most valuable aspect of the Foundry BC Platform. The opportunity to read the recovery narratives of their peers served as a significant motivator for youth to continue using mHealth services. Furthermore, participants reported that this feature allowed service providers to familiarize themselves with the background stories of youth prior to their sessions, thereby enhancing the overall user experience and promoting a more informed and supportive interaction.

You can just read my story, and kind of know in advance what you've been through. So they know, what's he been through? So that's kind of like my favourite part that I don't have to tell every single person my story over and over again.

(John, youth)

The second subtheme was using mHealth as a connection tool. All participants expressed that mHealth facilitating connections to resources was valuable, providing information for youth seeking services about how to initiate them, connecting those who had not yet seen a therapist to in-person services, and offering those already receiving in-

person services access to mHealth resources. *“But most people who use the chat function will end up doing a video session, and quite often then will engage in where it's appropriate and will engage in in-person services because they've been acclimatized”* (Jojo, nonclinical staff).

The final subtheme pertained to the content itself, which has been identified as a critical factor in attracting youth to the Foundry BC Platform. Many participants emphasized that the quality of the resources and articles was paramount (“The articles and tips on the app are so helpful”), with a strong focus on youth-centred content that was often authored by peers. Participants reported that this content was presented in an accessible and engaging manner, tailored to meet the needs of a diverse audience. Participants across all three groups noted that such thoughtful curation not only enhanced the platform’s appeal but also fostered a sense of relevance and connection among youth users.

Theme 2: Individual Factors. Three subthemes were identified as facilitators for mHealth adoption within this main theme of individual factors.

The first subtheme was that youth used mHealth as an escape from the challenges associated with in-person services. When faced with the frustrations of attending in-person appointments, the solutions offered by mHealth motivated youth to engage with services. In this context, they perceived potential risks associated with seeking traditional

care and found a sense of security through mHealth alternatives. As one youth, Chelsea, noted the reason many of their peers accessed mHealth was *“They feel judged by therapists and they don't want to access in person.”* Also, *“It is much easier to deal with social anxiety during online chat and you don't have to show your face”* (Sunny, youth).

The second subtheme emphasized the role of self-motivation among youth. Concerns and worries about their own individual health served as a significant motivator for youth to seek out mHealth services, driving their engagement and willingness to adopt these digital solutions.

I think there's a whole spectrum, and I think on one end they come out of desperation, they feel like their life is crumbling and they've tried to do it on their own and it's collapsing. And they're at breaking point. On the other end of the spectrum, it speaks to the reduction in mental health, stigma, and counselling in general, maybe going to a counsellor could help me have a better life. I think those are the 2 ends of the spectrum. (Jacob, clinical service provider)

I think my motivation was, I just needed like help at the end of the day, and I really thought that I could really gain some skills. (Camile, youth).

Last, although privacy concerns were an identified barrier for mHealth adoption, using mHealth to address those concerns was also reported by most youth. It was

valuable to note that one participant reported privacy concerns as both a barrier and a facilitator for mHealth adoption. There were concerns that using mHealth may breach data security and confidentiality, but all stakeholders acknowledged the capability for youth to protect themselves behind screens. “It is easier to stay low key on the app, you can just delete the app and everything is gone” (Sisi, youth).

Theme 3: External Factors. Two subthemes were identified as facilitators in this theme group. When exploring the motivation that drove youth to use mHealth service, a word that was mentioned commonly was “friend.” The outside support from someone’s friends or peers in general was important.

I had a few friends who also did it, so I guess they were generally my motivation, cause we would talk about these things, and I would hear that. Oh, like they don't think they don't have any stigma present. (Sisi, youth)

The second subtheme in external influences was the use of mHealth to establish a secure environment. Some youth expressed feeling unsafe when attending in-person appointments, especially in smaller communities where encountering therapists who were family friends could jeopardize their privacy and sense of security. “They'd be more willing to sign up and come in as long as they don't have a helicopter parent who's like, what are you doing? What are you doing? What are you doing?” (Kelly, clinical service provider).

In such instances, participants indicated that the adoption of mHealth was essential for establishing a safe environment for youth. So although the lack of a safe space was viewed as a barrier to mHealth adoption by certain stakeholders, it was perceived as a facilitator by individuals from diverse personal and cultural backgrounds. This divergence underscored the complex interplay between perceived safety and the motivation to engage with mHealth services, highlighting the need for nuanced understanding among stakeholders.

5.3.4 Research Question 3: Sustainability of mHealth Within IYS

Two major themes were identified with respect to the sustainability of mHealth service. Table 15 presents a full list of themes and subthemes.

Table 15

Factors Influencing mHealth Sustainability

Theme	Subthemes	FY	FC	FNC
Quality of mHealth itself	Long-term quality improvement	+	+++	+++
	Service quality	+	++	+
	Cost-effectiveness	+	++	+
External support	Promotional campaign	++	++	-
	Outreach and engagement	+++	++	++
	Connection to “real-life” service	++	+	+
	Policy	+	+	+

Note. FY = frequency of mentions by youth; FC = frequency of mentions by clinical service providers; FNC = frequency of mentions by nonclinical staff; +++ = very

frequently mentioned by most participants; ++ = frequently mentioned by around half of participants; + = occasionally mentioned by one or two participants.

Theme 1. Quality of (mHealth) Technology. The first theme essential for the sustainability of mHealth was the quality of the mHealth product itself. Three subthemes were identified within this theme.

First, the necessity for long-term quality improvement emerged as a significant concern, particularly among clinical and nonclinical staff. Participants highlighted that the absence of follow-up resources to support the quality improvement process represented a substantial threat to the sustainability of mHealth services. Without resources, mHealth initiatives risked failing to meet the evolving needs of both youth and service providers, ultimately jeopardizing their effectiveness and relevance. “We got a certain amount of funding and resources to build the app, develop the app but not necessarily to make modifications unless it’s getting in the way of like the apps usability.” (Lulu, clinical service provider).

The second subtheme was related to the quality of health and wellness services provided. Participants reported that sustainable service delivery must provide resources that are more comprehensive than what youth could get from physical centres. “Going through all these different steps and you see ‘currently not available’ is kind of annoying”

(Sunny, youth). Participants proposed that content should be “not boring,” “fun,” and “interesting.” The developers in particular wanted to ensure that mHealth did not turn into an “mHealth version of a hospital room.” In addition, with the rising attention given to artificial intelligence (AI), participants reported that it was essential that the resources from mHealth service were not easily replaceable by generative AI chat. Participants reported that ensuring the quality of service was fundamentally dependent on comprehensive staff training, which was recognized as a critical component of mHealth user retention. Participants emphasized that properly trained staff not only enhanced the overall user experience but also fostered trust and satisfaction among users, thereby contributing to sustained engagement with mHealth services within IYS.

“After 20 min the counsellor was like I'm sorry my dog's here, I would have to leave this session to take him out on a walk! It was really unprofessional” (John, youth).

The final subtheme pertained to cost-effectiveness. Many youth said that the origin of support – whether from the private sector or governmental organizations – was largely inconsequential. Their continued engagement with mHealth solutions was reported to be contingent upon the services remaining free of charge.

Theme 2. External Support. The second theme involved the external factors influencing the sustainability of mHealth services. This theme contains four subthemes.

The first subtheme was promotional campaigns, characterized by the imperative to “advertise everywhere.” Participants frequently emphasized the importance of diverse advertising methods, including social media, bus stops, subways, and the distribution of flyers. The overarching objective of these efforts was to enhance public awareness and inform individuals in the community of the existence and availability of mHealth IYS services. *“Constantly have ads on Facebook or social media, or some buses. Just be like, hey, you need help? Here's an app. We can help you.”* (John, youth).

The second subtheme was the need for an outreach and engagement framework within the health care system. All stakeholder groups emphasized the importance of the mHealth team consistently communicating with partners in schools, local clinics, community centres, and health organizations. Participants underscored that this engagement was crucial for identifying the desired features of an effective mHealth service. By incorporating these insights, participants felt that stakeholders could more effectively align the services with the specific needs of youth.

If you're building a service that is supposed to be useful for them. Then you need to co-design it with them. Co-design led to the success and adoption of over 10,500 users of the platform. The only reason we could make this work is we co-designed everything with youth. (Allison, nonclinical staff)

The third subtheme concerning external support was the necessity of integrating mHealth services with physical centres that offer in-person care, to keep modality options open. Although the extent to which mHealth can entirely replace transitional face-to-face services was debated – illustrated by comments such as “no parents involved at all” and “it worked well in extreme situations like COVID” – most participants advocated for a "hybrid model" as the optimal configuration for mHealth services. As articulated by nonclinical staff Alex, “I think its integration; it shouldn't be parallel systems or anyone replacing anything.”

The last subtheme was policy and operational support for sustainability of mHealth within IYS network. Participants noted that there was a need for a comprehensive regulatory framework that considered the diverse needs of all stakeholders and how they could work together to achieve the best outcomes over time.

Service providers not having people on their teams who know how to implement good mHealth solutions, it is also hard to find experienced clinicians on the app. We need someone who can speak both languages so they can understand the workflows of clinicians, and how they operate on a day-to-day basis, and understand what people are looking for in their services, to see if the technology is going to meet that need or create additional barriers. (Allison, nonclinical staff)

5.4 Discussion

The findings of this study provide critical insights into the perceptions of youth, service providers, and non-clinical staff regarding mHealth services within the IYS network perspectives on the development of a sustainable, youth-centred mHealth system to improve mental health outcomes. Through detailed analysis of qualitative data from youth, service providers and nonclinical staff, we identified themes to understand stakeholder perceptions of mHealth integration and sustainability (Table 12). We also identified barriers and facilitators of mHealth adoption and integration (Tables 13 and 14) and sustainability within an IYS network (Table 15). These findings also offer additional insights into the factors influencing the implementation and long-term sustainability of mHealth interventions.

Previous studies have predominantly focused on researching mHealth adoption through TAM, emphasizing perceived usefulness (PU) and ease of use (PE) as core predictors of user acceptance and intention to use the technology.^{201–204} more comprehensive reviews have also identified other contributing factors, such as design and technical concerns, cost, time, privacy and security, social influence, self-efficacy, trust, technology anxiety, performance and effort expectancy, and resistance to change.^{205,206} Although inner drivers like self-efficacy were associated with PU and PE,^{207,208} our study suggests looking beyond app usability. Our results emphasized the importance of

sustainable implementation planning, meaningful engagement of multiple stakeholders, and resourcing mHealth solutions over time, particularly regarding the intersectionality across technology, youth needs, and the context within the organization, highlighting the interaction and adaptation among all these factors.²⁰⁹ Our results suggested that it is imperative to devote attention to such systematic analysis of the factors influencing mHealth utilization among younger populations, who are often perceived as primary proponents of technological innovations.²¹⁰

This study revealed that, beyond the inherent characteristics of mHealth platforms, concerns regarding safe spaces and privacy emerged as distinct subthemes that functioned both as barriers and facilitators to engagement. Our results also suggested that it is essential for service providers and developers to acknowledge that the concept of a "safe environment" is subjectively defined by each individual, underscoring the need for a nuanced approach in developing and recommending safe usage scenarios for mHealth services, as there is no singular correct solution that universally applies to all youth²¹¹ as they follow unique developmental paths.²¹² This finding resonates with the importance of considering "condition" and "adopter system" for mHealth implementation,²⁰⁹ which truly emphasize the diverse needs of populations and the importance of tailoring interventions to these complexities.

We also found that it was important to not only conduct a horizontal comparison across the three participant groups, but also a vertical comparison across the three research objectives. This integrated approach enabled us to elucidate the interconnectedness of various themes. For example, youth living in rural communities, who often encountered transportation barriers, perceived mHealth as an instrumental resource for overcoming these challenges, thereby placing a high value on facilitators that helped bridge this gap. Conversely, youth who reported belonging to cultures that stigmatize mental health regarded mHealth as a refuge, where they could engage with services safely and discreetly. For these individuals, features that enhance privacy and security were paramount for facilitating the adoption of mHealth. By examining these relationships further, we attained a more nuanced understanding of the multifaceted challenges faced by youth, the impact of wider context surrounding different groups of youth, and external policy alignment supporting the establishment of safe online spaces.²⁰⁹ They have the capacity to in turn inform the development and implementation of more effective mHealth solutions targeted for the evolving needs of diverse youth.

Current research on mHealth adoption reveals a notable gap in understanding the sustainability of mHealth services and implementation over time, especially within youth populations who access the IYS network.^{172,213} Much of the existing literature focuses on factors that influence the ongoing implementation and use of these

applications.^{201,207,214,215} This study aimed to extend the discourse beyond mere app usage duration – a commonly employed metric – to highlight the importance of quality engagement and outcomes, including service integration. The results suggest that effective outreach, meaningful engagement, and participatory co-design are critical components for the sustainability of mHealth services.^{216,217} However, there is still a lack of evidence that clearly defines these concepts or offers a comprehensive framework for understanding the engagement processes and key characteristics of successful engagement experiences.^{103,218} Future youth-centred and embedded research opportunities hold significant potential to explore these factors in greater depth, thereby enhancing understanding and informing regulatory frameworks that support effective mHealth interventions for youth.

Overall, this study provides valuable insights into the integration of mHealth within an IYS network by examining diverse perspectives of various stakeholder groups. Youth articulated their motivations for engaging with the Foundry BC Platform, highlighting specific design characteristics that resonated with their needs. In contrast, clinical service providers emphasized the challenges they encountered regarding scheduling and communication, noting that mHealth solutions can inadvertently diminish the effectiveness of direct interactions, particularly when youth prefer app-based

communication. Meanwhile, developers (nonclinical staff) focused on broader conceptual goals, such as designing services that empower youth and foster a sense of control.

Our findings underscore that, although existing literature emphasizes user experience, user interface design, and the intervention's overall effectiveness, these factors alone do not comprehensively capture the dynamics influencing the sustained use of mHealth services among youth and clinicians.^{201,219,220} These findings call for a paradigm shift towards more holistic approaches that consider contextual, relational, and experiential dimensions of mHealth within an IYS setting, consistently centring the needs of youth and clinicians. By broadening the focus of future research to encompass these multifaceted elements, effectiveness and sustainability of mHealth interventions will be enhanced, ultimately better serving the health and well-being of youth populations.

Limitations

Although our study was an in-depth analysis of qualitative data, it is important to acknowledge certain limitations. First, we relied exclusively on one-on-one semi-structured interviews for data collection with 16–24-year-olds, which may constrain the generalizability of our findings to younger youth accessing IYS. The majority of youth in our sample were proficient in English, potentially limiting the inclusivity of our findings. This is especially relevant since language was identified as a barrier to mHealth use. Future research should prioritize the recruitment of a more diverse cohort, including

youth for whom English is not the first language, to ensure a broader range of experiences and perspectives are captured. Additionally, our recruitment strategy relied on social media outreach, which likely recruited participants who were proactive and comfortable engaging online. To obtain a more representative view, future studies must develop strategies to amplify the voices of less active youth who may be reluctant to initiate contact or share their experiences independently. Addressing these limitations will enhance the robustness and applicability of future research in this critical area.

5.5 Conclusion

This study offered a critical exploration of the complexities and opportunities surrounding the adoption and integration of mHealth within an IYS framework, drawing on qualitative insights from diverse stakeholder perspectives. By uncovering key themes, we revealed the nuanced perspectives of mHealth users, service providers, and developers, while identifying the complex barriers and facilitators that impact mHealth adoption and long-term sustainability. Our findings highlight the imperative for holistic approaches that transcend conventional usability metrics, emphasizing the importance of addressing youths' intrinsic motivations, privacy and safety concerns, and the external barriers to accessibility they face. In doing so, we advocate for a more inclusive understanding of the factors that drive engagement with mHealth services, particularly focusing on how to reach less-vocal youth whose voices are often overlooked. Looking

ahead, it is crucial for future research to actively incorporate principles of engagement and co-design in the development and implementation of mHealth solutions. Such efforts will not only enhance the relevance and effectiveness of these services, but also ensure that they are truly reflective of and responsive to the diverse needs of young users and those providing the services. By prioritizing these areas, we can contribute to a more equitable and impactful landscape for youth mental health support through mHealth innovations.

Chapter 6: Study 4 Qualitative Analysis

“You Can’t Categorize Lived Experiences”: Understanding Youth Engagement in Mobile Health in an Integrated Youth Service Setting

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Summary

Background. Youth mental health is a critical global issue, often compounded by stigma and fragmented health and wellness services that limit access. In Canada, integrated youth services (IYS) aim to address these challenges by providing a single access point for a range of youth-focused health and wellness services. Youth engagement plays a crucial role in the development, expansion, and evaluation of IYS. In 2020, mobile health (mHealth) services were integrated into some IYS as a key part of the service offering. This study explored factors affecting youth engagement in mHealth services within the IYS model and sought to identify strategies to promote sustainable and effective engagement practices in these services.

Methods. We conducted 23 semi-structured interviews with youth, service providers, and nonclinical staff within an IYS network in British Columbia, Canada. Using a deductive thematic analysis, and guided by the consolidated framework for implementation research, we identified key factors facilitating or hindering youth engagement in mHealth services within the IYS framework.

Results. We identified the following domains and main needs: (a) innovation domain, the need to understand the core value of engagement for mHealth; (b) outer setting domain, the need to coordinate external partners and policy; (c) inner setting domain, the need to resolve management change challenges in teams within organizations; (d) individual domain, the need to identify youth and staff roles during engagement and recognize power imbalances; and (e) implementation process, the need to assess specific needs, plan ahead, and develop tailored coping strategies.

Conclusion. The study highlighted that achieving meaningful youth engagement in the development of mHealth services is a complex process that demands a shift away from tokenistic approaches towards inclusive and sustainable practices that genuinely respect and incorporate diverse youth perspectives. Key barriers, such as the absence of regulatory frameworks, limited understanding of youth engagement, power imbalances within virtual health care settings, and difficulties reaching equity-deserving youth, should be addressed to create more effective and equitable engagement strategies in

mHealth. Future research should focus on establishing iterative learning systems that evolve with feedback, creating safer and more supportive spaces for youth participation, and developing targeted strategies to engage underrepresented youth populations.

6.1 Introduction

Youth mental health has emerged as a critical global health issue, with increasing recognition of its impact on individuals and communities.^{181,221} Traditional mental health services struggle to provide care to youth aged 12 to 24 due to barriers like accessibility, stigma, and inequality,^{222,223} leading to calls for developmentally appropriate solutions.

In Canada, the mental health system has faced longstanding criticism for its fragmentation, inadequate resources, lack of responsiveness, and inefficiency in addressing the diverse needs of youth across provinces and territories.²⁴ IYS have become a key Canadian solution by offering a single access point to various health and wellness services, including mental health and substance use (MHSU) care, physical and sexual health services, peer support, and social services (Figure 8).¹⁵⁵ Alongside the establishment of IYS, the COVID-19 pandemic was a catalyst to transform the IYS system by introducing mHealth services.¹² Since 2020, mHealth has become an alternative modality to IYS in-person service access and provision.¹⁷ Early evidence showed integrating mHealth within an IYS setting met an unmet need by offering

accessible, scalable, and flexible support options that were culturally and developmentally specific.¹⁶

Despite its potential, the sustainability of youth mHealth applications and interventions remains a significant concern for many IYS developers, health providers, and policy makers.²²⁴ Current mHealth tools in other youth mental health sectors are highly unregulated, and vary significantly in terms of evidence level, measurement, delivery modalities, and evaluation standards.¹⁷ The user retention rate of mHealth apps is also concerning, particularly given the substantial resources invested in their development, raising fears that these services may disappear shortly after their launch.^{225,226} A previous study from our team gathered perspectives from mHealth stakeholders on what contributed to the sustainability of mHealth services. Regular meaningful engagement was identified as a crucial element with stakeholders emphasizing its importance for understanding the desired features of a successful mHealth service and integrating these insights to better accommodate the needs of youth.

At this time, the concept of engagement in mHealth development is unclear in the literature.¹⁷ In some research studies, participant engagement was defined in terms of factors reflecting service utilization, such as the number of intervention accesses, time spent using the service, frequency of use, and depth of content accessed.^{98,143,144} The concept of engagement in other studies was linked to user retention, and researchers

assessed engagement levels to determine how to keep users connected with mHealth services.²²⁷

An alternate interpretation of “participant engagement” in the literature valued and described a civic engagement perspective: the way in which individuals or communities participate and contribute to the development of interventions or processes in their societies. In the context of mHealth development for youth mental health and IYS settings, this study aimed to explore this definition of engagement, with an emphasis on the importance of how youth are active, informed, and responsible actors in the development and scaling of mHealth interventions to promote health and wellness of themselves and their peers.

As IYS moves towards mHealth being a core component of the service model, it is critical to have a strong definition of what engagement means from the perspectives of diverse stakeholders who develop and use mHealth IYS services. For this study, the overarching goal was to understand what constituted successful youth engagement implementation in an IYS setting to support mHealth service sustainability and benefit all stakeholders involved. Specifically, the research questions were (a) What are the factors that influence youth engagement within an IYS setting to support mHealth technology and service development? and (b) What actions are needed to ensure meaningful youth engagement in mHealth development and sustainment planning over time?

Figure 8

Model of Integrated Youth Services Core Service Streams



Note. Integrated Youth Services (IYS) combines multiple service areas and supports for what you need when you need it. IYS usually cover most of these service areas.¹⁵⁵

6.2 Methods

6.2.1 Study Design

This study used semi-structured in-depth interviews with three priority participant groups within an IYS network. This included youth who received care, clinical service providers who delivered care, and nonclinical staff who organized systems of care

delivery. All components of this study received ethical approval from University of British Columbia Office of Research Ethics Behavioural Research Ethics Board (H22-03454).

6.2.2 The Consolidated Framework for Implementation Research

The consolidated framework for implementation research (CFIR) is a widely used framework that provides a comprehensive structure for evaluating implementation processes across various settings.²²⁸ The constructs of CFIR are organized into five domains: intervention characteristics, outer setting, inner setting, characteristics of individuals, and the process of implementation.²²⁹ By categorizing these elements, CFIR facilitates the systematic assessment of potential barriers and facilitators impacting the uptake and sustainability of an intervention. This study applied CFIR to guide our deductive qualitative data analysis, ensuring a thorough examination of contextual factors influencing the implementation of youth engagement in an IYS setting.

6.2.3 Study Setting: Foundry

With a proof of concept established in 2015, a province-wide IYS initiative called Foundry was developed, implemented, and expanded to enhance healthcare access for youth in British Columbia (BC), Canada. Foundry launched its virtual service in April 2020, specifically the Foundry BC app, allowing youth to access online health resources; schedule appointments with service providers; and communicate with service providers

using chat, audio or video calls. Participants for this research were recruited within the Foundry network. We chose to focus first on Foundry because it is one of the most established IYS network in Canada to date. At the time of this study, Foundry had 17 centres open, 18 in planning, and a fully operational mHealth service. As well, Foundry has a backbone operation called Foundry Central office (with > 130 staff) that supported all centres and the virtual service to deliver evidence-based services to youth and families. This situation provided an ideal opportunity to explore the concept of engagement within a new service (mHealth) and a growing system (the Foundry network).

6.2.4 Study Sample

We recruited three groups of mHealth stakeholders.

Group 1: Youth Users of the Foundry App. The inclusion criteria for participants required youth to be between 16 and 24 years old (those aged 15 and under were excluded due to the need for parental consent), able to communicate in English, and users of the Foundry app within the past year. Recruitment was conducted through posts on social media, which provided a brief overview of the study and outlined the expectations for the 1-hour interview. To ensure a diverse sample of app users, no limitations were placed on the frequency or purpose of mHealth usage.

Group 2: Clinical Service Providers. We recruited Foundry service providers, including counsellors, social workers, and primary care practitioners, who had used mHealth for care delivery (e.g., virtual counselling, remote information sessions, online peer support) for this group. Most participants were purposively selected from Foundry Richmond, the first centre to fully integrate the Foundry app into its clinical services. Snowball sampling was also employed to expand recruitment.

Group 3: Nonclinical Foundry App Staff. We invited technology and implementation experts involved in the design, development, and implementation of the Foundry BC app for interviews to provide a comprehensive perspective on mHealth, alongside youth users and clinical service providers. This group was referred to as "nonclinical staff" for the remainder of the study. After obtaining ethical approval, the Foundry communications team distributed email invitations to eligible nonclinical mHealth staff, ensuring confidentiality and allowing them to make an unbiased decision about participation. The invitation included a brief overview of the research project and its significance.

6.2.5 Data Collection

Qualitative data were collected through 23 one-on-one semi-structured online interviews until saturation. The open-ended questions were informed by previous research²³⁰ and based on how participants thought of engagement and their past youth

engagement experiences. All interviews were recorded and transcribed using Zoom. Notes were taken during the interviews to provide additional reference for later data cleaning processes, and all participants were given an alias throughout to protect privacy. Additionally, to enhance the credibility of the findings, we incorporated a form of member checking by sharing a summary of the preliminary themes with one youth and one nonclinical staff, selected based on their motivation shown during interviews and expressed interest in contributing further. Their feedback was incorporated into the final qualitative result interpretation to ensure they align with participant experiences.

6.2.6 Data Analysis

A deductive thematic analysis²³¹ was conducted using the domains and constructs outlined in the updated consolidated framework for implementation research (CFIR).²²⁸ We created a coding scheme that mapped back to the CFIR constructs, predefining the codes so that we could deductively identify relevant patterns in our data and systematically categorize the data according to the CFIR framework. Before coding the data, the coders (XD, SB) reviewed and discussed CFIR constructs definition thoroughly, coming to a collective understanding of the codes. We recognize the coding and data interpretation was informed by the positionality of the authors, acknowledging their distinct perspectives and experiences. Author XD, a PhD candidate, brought a research focus on improving health care access, particularly for youth navigating barriers to

mental health services for equity-deserving population. Author SB is an occupational therapist and clinician with extensive experience in youth mental health, offering a practice-based perspective on the integration of mHealth interventions.

Throughout the analysis, several strategies were employed to ensure trustworthiness. We used triangulation of researchers and data sources, with both XD and SB coding and reviewing the data collected from different stakeholder groups independently and collaboratively. Regular peer debriefing sessions with co-authors at weekly research meetings were conducted throughout the duration of analysis to reflect on emerging interpretations and assumptions. We prepared time for deviant or negative cases; we were ready to discuss qualitative data that contradict the existing CFIR construct. Data saturation in deductive analysis was determined when all framework categories were fully represented and no additional subthemes emerged.

Once the data were coded, we verified key themes and patterns by reviewing the coded data under each CFIR domain to look for commonalities and draw connections between the constructs. We systematically examined on how existing CFIR constructs explained our data and identified gaps in the frameworks' application to the youth engagement in an IYS mHealth context.

6.3 Results

A total of 23 mHealth stakeholders participated in this study, with 12 youth having used the Foundry app during the past year, six service providers, and five nonclinical staff who were deeply involved in the development of the mHealth services across the IYS network. Half of the youth in the study reported having strong engagement experience including volunteering for engagement programs, participating in focus groups, or participating on local or provincial youth advisory committees. Table 1 summarizes the demographic characteristics reported by the participants.

Table 16

Summary of Demographic Description of Three Groups

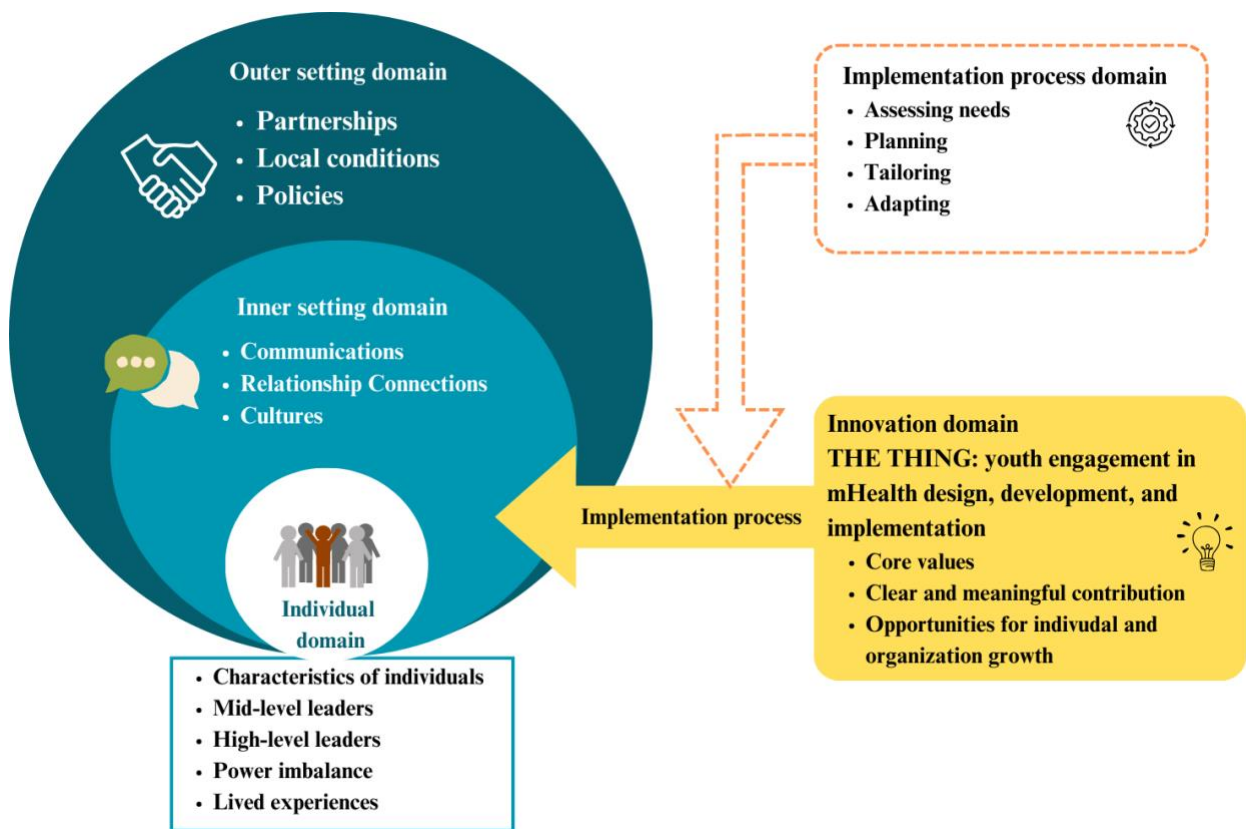
Characteristic	Youth (<i>n</i> = 12)	Service providers (<i>n</i> = 6)	Nonclinical staff (<i>n</i> = 5)
Age <i>M</i> (range)	20.4 (18–24)	32.8 (23–45)	35.6 (29–46)
Self-reported gender (<i>n</i>)			
Woman	10	4	3
Man	2	1	1
Nonbinary	-	1	1
Has engagement experience <i>n</i> (%)	6 (50%)	1 (16.7%)	5 (100%)
Years of professional experience <i>M</i> (range)	-	4.2 (1.5–7.0)	14.1 (8.0– 23.5)
Years with Foundry <i>M</i> (range)		2.5 (1.5–4.0)	3.4 (2–5)

During one-on-one interviews, participants discussed their understanding of the implementation of meaningful youth engagement to support the development of mobile

youth mental health services. Figure 9 presents an overarching framework for youth engagement implementation research, adapted from CFIR and informed by our qualitative data analysis results. Each domain is explained in detail in this chapter and participants’ perspectives are summarized along with representative quotes.

Figure 9

Consolidated Framework for Implementation Research Informed by Study Results



Note. Adapted from the updated consolidated framework for implementation research based on user feedback.²²⁸

Innovation Domain

The CFIR defines *innovation* as “the thing” being implemented, which in this study ²²⁸ is the youth engagement plan in mHealth. This section examines participants’ understanding of the concept and core value of “engagement,” setting the foundation for discussions on how an engagement plan should be implemented. Participants emphasized that when engagement was effectively executed in mHealth, it involved clear communication of the project’s core vision, with well-defined roles that allowed both youth and the organization to make meaningful contributions. Additionally, it provided opportunities for continuous learning and growth for both youth and organizations, extending beyond the immediate tasks of the project.

Some participants viewed engagement as a valuable means of treating youth as active mHealth product users, ensuring their ongoing connection to virtual services through consistent outreach. Participants also highlighted engagement as a learning opportunity, focusing less on the mere measure of participant involvement and more on it as a mutual, iterative process of learning.

Collectively, participants acknowledged that engaging youth in mHealth design and development provided organizations with valuable insights into current youth trends, preferences, and the dynamics of online platforms. They emphasized the significance of

engagement to enhance service effectiveness and accessibility – especially for reaching underserved populations – and transform their lived experiences to meaningful contributions.

The whole point of engagement is to access like that one youth. It takes that one youth who in their shell and is hiding because no one is that no one is reaching out to them, and they feel like they're alone. (Rachel, youth)

The only reason the Foundry BC platform has been successful at all is because we designed it with young people at the beginning. Most of the technology, you see, fail because they were kind of designed with only service providers and nobody else. And they realize, after implementing it is that they left out the voices of the only people they don't pay to use the platform. (Allison, tech implementation manager)

Outer Setting Domain

The *outer setting* studied was the wider external system and context that impacted youth engagement to support mHealth IYS design, development, and implementation.

Partnerships. External connections and partnerships with schools, community centres, and other health care facilities were identified as key factors facilitating youth engagement to support the development and sustainability of mHealth services.

Participants described these partnerships as including collaborative educational activities,

such as in-person presentations, workshops, curricula, and conferences, aimed at raising awareness and creating opportunities for youth involvement in mHealth development.

And we also talked about youth would want to see help programs out there, I think there was workshops in general that would definitely help youth. Either go into the workforce or help them with their career building, or just mental health in general (Rice, youth).

Participants highlighted the value of identifying champions within schools and communities – individuals who could advocate for and promote the concept of youth engagement at Foundry to support mHealth innovations and growth. Participants said that these champions played a crucial role in increasing local support for both the development of services and the integration of mHealth initiatives with other community-specific initiatives.

Some youth shared that their engagement with Foundry often led to new partnerships and opportunities for professional growth. For instance, one youth participant described how their involvement with Foundry resulted in an international collaboration on a global health project. This project focused on engaging youth from lower-resourced areas to co-design mHealth services tailored to their specific living conditions, demonstrating the broader impact of youth engagement in the development of mHealth solutions.

Right now we're trying to combine both of the Youth Advisory Committees [here and in Vietnam]. Since youth in Vietnam doesn't have anything like Foundry, so what we're doing with the Vietnamese youth right now is that we're trying to co-design an app for them, to give ideas to help and just be a general support system for the youth, because I know in Vietnam there may be a lot more stigma around youth mental health. (Sisi, youth)

Local Conditions. Participants identified environmental and political conditions as barriers impacting the implementation of youth engagement in mHealth development and sustainability planning. Some youth reported that they did not feel like participating in such opportunities because of stigma surrounding mental health in their communities or within their own families. Some youth noted that their schools and parents could “get territorial” knowing their youth have been asked to talk about potentially sensitive health information. Participants stressed the importance of understanding local context before asking youth to engage in novel opportunities, such as mHealth technology and service development. For example, participants who had experiences working with Indigenous communities reported some local centres used traditional healing power as a part of their therapy sessions, which was not usually compatible with integrated mHealth tools. Participants also identified practical factors, such as understanding the available resources (e.g., local Wi-Fi connectivity, how to pay youth for their time) and what

support was needed from the community (e.g., from teachers, parents, Elders) to allow youth to engage in such opportunities.

We don't have all the context of what that community or within the school looks like. We don't have context of their Wi-Fi, what their policies are on using phones. We need to work with them and know how [engagement] integrates within their setting. (Alex, product adoption lead)

Policies. A major barrier to implementing meaningful youth engagement in mHealth development was the lack of legislation, regulations, professional guidelines, or standards that mandate youth involvement in all processes related to mHealth development and sustainability. Participants stressed the need for regulations to ensure that youth are consistently engaged in the creation of technology and services intended for them. Participants noted that these regulations should also ensure that youth feel supported throughout the entire process and have access to all the necessary information to participate, including the freedom to disengage if they choose.

Participants noted that establishing policies around youth engagement could be highly beneficial in defining clear roles and responsibilities before the implementation phase begins. Furthermore, support for engaged youth was considered essential by all participant groups. They pointed out the complexities within communities that influenced who could provide support to youth and who could not. Building strong infrastructure

within the organization was seen as crucial for creating the systems and processes needed to onboard youth, support them during the project, and follow up afterward for ongoing work or professional development. The next section elaborates on this theme in greater detail.

Probably there are concerns around credentialing. How do you verify that the person who's providing a service over an app is in a position to be providing mental health care? If I had a teenager, I would want to know that they're connecting with someone in a regulated health profession or with an organization that has some reputability. (Lulu, clinical service provider)

Inner Setting Domain

In this study, the *inner setting* was the Foundry IYS backbone organization, where youth engagement planning and execution often took place. The backbone organization included service providers delivering care both in-person at Foundry centres and online via the Foundry app, as well as nonclinical staff working on program development and implementation. This included youth and family engagement specialists, evaluation specialists, and communications staff.

Communications (Information and Technology Infrastructure). Providing multiple ways for youth to submit feedback and communicate was recognized as a crucial aspect of meaningful youth engagement in mHealth, particularly for those who were less

vocal and prefer more discreet methods to express their opinions. Participants highlighted that the current fragmented communication system forced them to manually collect and organize information from various channels, such as phone calls, texts, websites, and apps. This lack of integration was reported by participants to be especially problematic in engagement efforts involving multiple stakeholders, as it led to inefficiencies, increased the potential for errors, and disrupted the timely coordination of responses. As a result, participants noted that quite often the quality and effectiveness of youth engagement were diminished.

There's no way to look at a youth's contact information unless we go to the schedule in another old system, and that's only if they book with us on the phone before [when there was no app]. It's annoying that if we have multiple modes of communication let's say if we have all four types for an appointment time you can't edit those times in the same templates or same email schedule. (Serene, service provider)

Relationship Connections. The involvement of all stakeholders was identified as the primary facilitator for meaningful youth engagement, requiring different parties and departments across the organization to sit at the same table with youth to facilitate engagement experiences. This collaborative approach would ensure that diverse perspectives were integrated, and more importantly, youth could feel heard and valued by

“people running the place.” At the same time, participants, especially nonclinical staff identified “change of management” as an internal barrier to the successful implementation of youth engagement in mHealth work. In an effort to include diverse perspectives, introducing new voices from different disciplines could sometimes disrupt existing rapport and engagement processes. For youth who were already involved, it would be essential to continuously create opportunities to build relationships with new members and understand their different priorities and work styles. When this was not effectively managed, participants noted that it resulted in inconsistencies in goal setting and undermined the trust that youth had built, leading to a loss of sustained engagement.

It would only help to be able to engage with the other participants, other groups, the doctors, or of people running it as well. It can be difficult... but if you're just meeting once every month, or once every 2 weeks to have updates on thing, and meet online too. It is really important to have that network going. (Rice, youth)

Culture. Implementing youth engagement required the culture to be youth-centred, nonjudgmental, open-minded, and respectful of diversity, which was essential for creating meaningful and effective solutions. Participants reported that this culture ensured that services met the specific needs of youth, making it easy to build trust and a sense of safety, thus encouraging participation while fostering innovative perspectives. Participants also reported the importance of recognizing each youth's lived experience as

unique and uncategorizable. Participants, notably youth, reported that respecting diversity should be strongly enforced in the mHealth engagement space because it ensured inclusivity and equity, valuing and addressing the unique challenges faced not only by equity deserving groups, but by every individual youth with their own barriers unique to their own communities and context.

I think what makes lived experience stand out is that it provides context to what is currently happening in the world and what is currently impacting youth. And it provides diversity perspective and contact. I think especially with the emphasis on intersectionality, there's a lot of things we can't categorize. I find in the academia world we tend to categorize certain things to better digest the information. But lived experience could be really unique to each person. And I think that's what makes it important that young people are talking about what they experience to give the world more insight, what they're actually struggling in real time. (Kate, youth)

Individual Domain

Results in this domain described factors contributing to mHealth youth engagement that were relevant to the roles and characteristics of individuals.²²⁸

Mid-Level Leaders. In this study, individuals with a moderate level of authority were youth engagement leaders and those hired to support engagement efforts.

Participants emphasized that the key facilitator for youth engagement in mHealth was ensuring that both youth leaders and participants fully understood their roles and how they could contribute. Beyond designing and refining services, involving youth in discussions with high-level leaders and decision-makers to shape mHealth planning and implementation strategies was seen as crucial for effective engagement. Youth noted that they needed adequate time and coaching to feel prepared for such meetings.

I think the main thing is to select people who have an intention to be there and have an intention to make a difference in the health and wellness world. I think that's something that I'm exploring as well is, how do we engage more youth to participate in a Youth Action Council? So maybe providing posters with the information that there is a Youth Action Council, and training and the benefits.

(Rice, youth)

High-Level Leaders. Participants highlighted the essential role of senior leadership in championing youth engagement within mHealth service delivery. These leaders were particularly valued for their ability to set clear, cohesive goals across stakeholder groups and address change management challenges, as discussed in the previous domain. The importance of strong leadership was also emphasized in the context of training new staff, ensuring they understand the value of youth engagement both within the organization and specifically in mHealth initiatives. Additionally, leaders

were seen as pivotal in fostering connections across organizations and communities, promoting the work, and articulating the role of youth in all aspects of mHealth, including community-specific initiatives. Retaining well-trained staff throughout the mHealth process was identified as a key strategy to maintain the quality of discussions around youth engagement and to ensure that processes were consistently in place to facilitate meaningful engagement whenever and wherever needed.

I think the communication piece, is something that's hard like there might be some young people who, if they knew about Foundry, they would be interested in accessing it, but they may not know where to go to learn about the youth engagement options, you need someone to be there to facilitate. (Allison, tech implementation manager)

Other Implementation Facilitators. Recognizing and finding strategies for the youth-staff-organization power imbalance was identified as a rising concern when implementing young engagement into mHealth service design and execution. In youth engagement in mHealth spaces, participants noted that the power difference was often rooted in traditional perceptions of adult versus youth roles, where adult staff held formal authority and decision-making power, and youth were often seen as participants rather than partners. Participants reported that staff were typically perceived by youth as more experienced and knowledgeable, which could overshadow the unique perspectives of

youth to design a service that is fit for purpose for them. Youth discussed how communication dynamics could play a critical role during engagement processes and often reflected imbalances, with staff leading discussions and youth having fewer opportunities to voice their opinions. Participants emphasized the importance of involving youth in decision-making and leadership roles. They advocated for providing training and resources, allowing youth to take the lead in mHealth planning and execution, and ensuring transparent processes for equitable participation. Youth felt that open communication empowered them and their peers to engage actively, fostering a sense of ownership and ensuring their voices were truly reflected in the development and implementation of mHealth services.

I think youth engagement ... there is a power imbalance. There are probably young people getting services from you right now who would like to be on your youth council, and that then creates some struggles in terms of if that same person's service provider is facilitating the council, how do you manage that power, how do you create the safe space for that young person to tell them your idea is terrible, so I think that's where it gets complicated. There has been structural stigma for people to not listen to their ideas. (Allison, tech implementation manager)

Participants also emphasized that it was essential to recognize that untrained youth (who had not participated in any health-related field training) had the capacity to engage meaningfully and deliver achievable insights and changes. Youth identified that they were experts in their own lived experience and brought rich experience to mHealth design and implementation. Youth identified that they were the target audience and “consumers,” and they had a better understanding of what a successful mHealth service for youth would look like. In addition to their lived experience, they reported that they felt that they brought deeper insights from their user experience with other online platforms they use for psychoeducational purposes such as Snapchat and TikTok.

We're not really trying to give professional advice here, we're just here to share a perspective and really try to make these services more accessible to youth, you wouldn't need health care perspective for that. It doesn't matter even if you have an education or not. All you're doing is just providing your perspective and hopefully making the services more usable for youth. (Camile, youth)

Implementation Process Domain

This section outlines strategies and activities participants suggested to ensure that youth engagement in IYS mHealth was systematic, well-supported, and continuously improving. Participants described these efforts as enhancing the successful adoption and sustainability of mHealth services within an IYS context.

Assessing Needs. Participants, particularly those with experience in youth engagement, underscored the necessity of expanding efforts to not only understand the requirements for mHealth services, but also to assess the diverse needs of youth participating in engagement opportunities. Youth cited a range of motivations for joining these opportunities, including incentives, volunteer hours, career development in the health field, sharing challenges encountered during their personal use of mHealth services, and a desire to make a positive impact in their communities. Each youth participant emphasized the importance of staff being attuned to their individual needs and personal circumstances when implementing youth engagement initiatives.

It depends on their interactive styles. Are they hands on? Are they verbal? Are they more interested in literacy stuff? What do they want out of it? And it really depends on individual differences, how they perceive social cues as well 'cause they could have a learning disability or a lot of mental challenges where they don't understand those certain social cues in social environment. (Emily, youth)

Planning. All participants emphasized the importance of having a well-defined youth engagement implementation plan prior to initiating any youth engagement processes in mHealth development or project implementation. They noted that, ideally, this plan should be co-designed by youth engagement experts – not necessarily from the mHealth field – but individuals who understand best practices for engaging youth in

virtual environments. Both youth and non-youth staff stressed the significance of clearly defining when, how, and where to engage youth in the design, development, and implementation of mHealth services.

Participants suggested that youth should be involved from the planning phase and throughout every stage of the mHealth process. They emphasized that youth engagement should be ongoing and sustained over the long term to ensure their input was consistently integrated and valued during the iterative mHealth design process.

Various methods of engagement were proposed, including online surveys, social activities at schools or in communities, focus groups, and youth advisory councils. Additionally, participants suggested numerous venues for youth engagement, such as academic institutions (e.g., high schools, universities), community spaces (e.g., churches, community centres, libraries), social support organizations (e.g., not-for-profit agencies), health care facilities (e.g., physician offices, parenting spaces), and online platforms (e.g., social media, virtual forums).

Some participants also proposed paid team roles for youth, which would involve more hands-on mHealth engagement, such as attending team meetings, participating in governance councils, and contributing directly to the development of technology.

Overall, participants acknowledged the complexity of youth engagement within the mHealth space and the need for it to evolve alongside technology and services. Although

the intrinsic value of youth engagement in mHealth was widely recognized, participants highlighted that adequate planning, resources, and infrastructure were essential to ensure its sustainability and effective integration across the IYS organization.

Tailoring and Adapting. Participants noted that youth engagement for mHealth involved iteratively implementing a variety of strategies to attract and encourage active participation in processes such as technology development, service planning, and evaluation of impact. Participants stated that ideal engagement would include an ongoing process of training youth so that they were ready for upcoming needs, rather than reacting to every situation as it arises. Participants noted that it was essential to support continuous recruitment and training efforts, along with offering competitive compensation, to help sustain youth in their roles and attract new youth to the work.

Participants noted that when compared to in-person services, mHealth design and service delivery were constantly changing. Participants suggested that IYS and other youth mental health organizations need to be exceptionally adaptable to the ever-changing needs of youth and communities, technology requirements, and outcomes. Although the online context could be perceived as one community, participants emphasized that it was indeed many more communities and youth coming to access mHealth services. Continuously planning for how to engage different youth in mHealth processes was critical to support all quality improvement efforts and stay ahead of

possible innovations and challenges. In summary, participants emphasized that not only mHealth technology must adapt and evolve over time, but also the methods used by Foundry to engage diverse youth.

6.4 Discussion

The aim of this study was to investigate what influenced the implementation of youth engagement to support the development of mHealth services in an IYS setting. We used CFIR as a guiding tool to analyze qualitative data collected from 23 semi-structured interviews with stakeholders on youth engagement in mHealth development and sustainability.

The CFIR identified the following domains and their main needs:

- 1) Innovation domain: The need to understand the core value of engagement.
- 2) Outer setting domain: The need to coordinate external partners and policy.
- 3) Inner setting domain: The need to address change management challenges within different teams and organizations.
- 4) Individual domain: The need to identify youth and staff roles during engagement and recognize power imbalances.
- 5) Implementation process domain: The need to assess unique needs, plan ahead, and develop tailored coping strategies.

Our results supported the existing literature which emphasized the critical role of engagement in the integration of mHealth services within IYS, particularly due to the diverse needs of youth from various personal and cultural backgrounds.²³⁰ Individuals from these groups perceived both facilitators and barriers to mHealth services in different ways, highlighting the importance of involving youth early in the design, development, and implementation phases of mHealth initiatives. Although CFIR has been used to explore factors influencing mHealth implementation, it has not been applied to studying youth engagement specifically, exposing a significant gap in the research.²³² Previous studies on the engagement of people with lived experience also pointed to substantial gaps in both understanding and effectively implementing engagement strategies.^{233,234} The findings of this study contribute to addressing some of these identified research gaps, providing valuable insights into fostering meaningful youth engagement in mHealth services.

In this study, the innovation domain identified a critical challenge of the lack of clarity among youths and their caregivers regarding the concept and fundamental value of engagement. This study pinpointed that youth, in particular, may question the authenticity of engagement efforts, fearing that their input will not be genuinely considered. To address this concern, results from our study suggested it was crucial to build strong, reciprocal relationships between youth and stakeholders - grounded in open

communication, shared decision-making, mutual learning, and sustained rapport - to help address uncertainty and skepticism. In addition to trust-building efforts, it is essential to establish regulatory frameworks prior to implementation to ensure compliance with legal and ethical standards while maintaining flexibility to respect the lived experiences of youth, expand ways and opportunities for youth to be a part of the engagement process, especially in contexts where professional health training is less involved.

The outer setting results drew attention to the unique connections to nature and traditional healing practices in remote and Indigenous communities, advocating for a more inclusive and culturally sensitive approach to engagement that incorporates local perspectives, even when working with technology and innovation such as mHealth. Additionally, findings in the individual domain underscored how traditional health care hierarchies could create barriers to engagement, with structural stigma often disempowering youth from openly sharing their experiences. An emerging literature exists about power dynamics in youth mental health, but more research is needed to understand the challenges and barriers in the mHealth context.²³⁵⁻²³⁷

This study highlighted a crucial objective of youth engagement: reaching out to those youth who feel isolated and left out. Although engaging passionate and empathetic youth for feedback is important and can lead to significant impact, it is equally important to consider the perspectives of those who are less inclined to participate in mHealth

processes.²³⁵ This includes youth who may be less vocal or whose participation is influenced by their wellness status. Strategies to engage these marginalized youth include reducing participation barriers, enhancing the benefits of involvement, providing regular feedback, and adopting youth-centred approaches that prioritize equity.^{238–240} Addressing these gaps and empowering youth to share their lived experiences is essential for driving meaningful health care changes and transforming youth-centred health systems.²⁴¹

The study also underscored the importance of local champions in coordinating and supporting health initiatives. Results suggest that school and community champions could serve as vital bridges for communication, helping to amplify the voices of underrepresented youth and developing strategies to overcome engagement barriers.

Our study outlined how future efforts to engage youth in mHealth development and design should prioritize tailored strategies that address the unique needs of different youth, particularly before implementation, to foster long-term collaboration and meaningful outcomes. Creating a safe and supportive environment for youth is crucial to avoid tokenism, where youth participation becomes merely symbolic and their influence is limited or nonexistent. A holistic framework, combining thoughtful planning and regulation before engagement, should be established to address both practical and structural barriers specific to mHealth, laying the foundation for effective and sustained youth involvement in mHealth service development. Additionally, to enhance

coordination and facilitate youth engagement both within and outside the organization, it is essential to develop an integrated system that connects various engagement partners, coordinates resources, offers guidance, and encourages continuous learning and knowledge sharing. This integration is especially important in mHealth development, as it often requires collaboration with external technology teams not traditionally involved in health care systems, necessitating additional efforts for knowledge mobilization and alignment across sectors.

Study Limitations

This study has some limitations. First, we interviewed three groups of mHealth stakeholders within a single IYS network, excluding external community partners and policymakers who often have significant influence in mHealth decision-making. As a result, our sample may not have fully represented broader mHealth stakeholder demographics. Second, although some youth were involved in advisory councils and other engagement activities, our recruitment strategy did not specifically target youth with extensive engagement experience. Future research should aim to include a broader range of external partners and policymakers to capture diverse perspectives and better understand the factors influencing successful youth engagement in IYS settings.

6.5 Conclusion

This study used semi-structured interviews to explore the key factors influencing youth engagement in the development of mHealth services within an IYS network. We identified critical facilitators and barriers across domains that highlighted the potential of youth engagement to enhance the effectiveness and sustainability of mHealth services while empowering youth voices in their health care journey. At the same time, we identified the need for pre-implementation considerations, the creation of safe environment for youth, development of an iterative learning health system, and strategies to reach unreachable youth, which are future endeavours aiming to optimize youth engagement implementation with the ultimate goal of improving stakeholder experiences and health outcomes.

Chapter 7: Recommendations, Significance, and Conclusions

7.1 Overview

This thesis includes four manuscripts: one published, two under review, and one in preparation for publication. Together, these manuscripts provide a comprehensive overview of youth mobile health (mHealth), covering the following topics: the current state of youth mHealth interventions in the literature, a practical example of mHealth use in integrated youth services (IYS), and two qualitative studies exploring the facilitators and barriers to mHealth implementation. Additionally, these qualitative study manuscripts emphasize the importance of youth engagement in all stages of mHealth development, including design, implementation, and evaluation. Below is a summary of the key findings from each manuscript chapter.

7.1.1 Mapping the Landscape of Youth mHealth Interventions (Chapter 3)

Through the use of scoping review methods, Chapter 3 synthesized existing evidence on the use of mHealth in youth mental health settings, highlighting significant gaps in level of evidence, resource allocation, and youth engagement. It identified the lack of standardized regulations governing mHealth technologies for youth mental health, particularly in areas of safety, measurements, and equitable access. The findings of this chapter underscore the critical need for youth-centred approaches in both the research and practical implementation of mHealth interventions. This emphasis lays a foundational

framework for the development of mHealth tools and practices aimed at improving outcomes and experiences for diverse youth populations.

7.1.2 Understanding Service Utilization Patterns in Youth Mental Health (Chapter 4)

Chapter 4 presented a retrospective cohort study that used a practical example of mHealth application in youth mental health. The study aimed to examine the demographic and clinical differences among youth accessing IYS through virtual, in-person, and hybrid modalities. By analyzing patterns of service utilization, this study illustrated how such data could guide resource allocation and enhance the effectiveness of service delivery models tailored to the distinct needs of youth. The study identified significant differences in the characteristics of youth accessing in-person, virtual, and hybrid services. These findings contribute to a deeper understanding of IYS modalities and their potential to address the diverse needs of youth populations. Moreover, they provide valuable insights for policymakers and practitioners seeking to optimize service provision.

7.1.3 Facilitators and Barriers in mHealth Integration (Chapter 5)

Using a qualitative inductive approach, Chapter 5 identified key facilitators and barriers to incorporating mHealth solutions within IYS settings. By exploring stakeholders' perceptions, the study provided practical strategies to address mHealth adoption and sustainability challenges. The research underscores the importance of

understanding both internal and external influences and co-design approaches, ensuring that mHealth services are aligned with the unique needs and preferences of both youth and other stakeholders, including service providers and mHealth developers and evaluators.

7.1.4 Framework for Meaningful Engagement (Chapter 6)

Through another qualitative study guided by the consolidated framework for implementation research (CFIR), a framework used to assess and understand the factors that influence the implementation of interventions, Chapter 6 further investigated the youth engagement and co-design components from previous studies. Meaningful youth engagement was a key theme in the three previous studies. I used this opportunity to dive deeply into the complexity of youth engagement in the mHealth field. This study investigated the factors that influence meaningful youth engagement during the design, development, and implementation stages of mHealth services, using the CFIR. The research proposed actionable strategies to improve youth involvement in the co-design process, with a focus on promoting equity, diversity, and inclusion. By linking engagement theory with practical application, the study presented a replicable model for future mHealth innovations. These findings enhance understanding of how to create and sustain youth-centred mHealth services, advancing both research and practice in this important field.

7.2 Summary of Findings

This dissertation advances the field of youth mental health by demonstrating the transformative power of mHealth in addressing service accessibility, effectiveness, and equity of mental health services. By integrating insights from a scoping review, quantitative cross-sectional analysis of a large existing data set, and two qualitative studies using both inductive and deductive approaches, this dissertation establishes a comprehensive foundation for developing and implementing mHealth services for youth populations. The findings can inform future mHealth initiatives across other youth mental health organizations, ensuring they meet the needs of youth and improve health and wellness outcomes in this crucial developmental stage.

The significance of this work is multifaceted, covering contributions in the theoretical, practical, and policy domains. In the theoretical domain, this dissertation underscores the importance of the youth-centred concept in developing, understanding and evaluating mHealth services over time. By using existing models like the technology acceptance model (TAM), principles of user-centred design (UCD), and the CFIR to guide the research, this dissertation bridges gaps between theoretical constructs and practical real-world mHealth applications. This approach ensures that mHealth services are developed in an intuitive, accessible, and inclusive setting, especially for equity-deserving populations. TAM helps to explore and identify that the technology should not

only be accepted by users, but also effectively designed with their input, leading to better user experiences and health outcomes. By integrating principles of UCD throughout each process of this dissertation from literature review, research question design and result interpretation, this work adopts the philosophy of emphasizing youth-centred engagement at every stage of mHealth design and implementation. The results suggest that by using iterative prototyping, feedback loops, and simplified interfaces, UCD aligns technology with user preferences, reducing adoption barriers. Additionally, it accounts for external constraints like organizational limitations and resource availability, enhancing sustainability. As noted in the limitation section, much of the context of my work did not allow for the full experience of engaging young people and users in the co-design of this research itself. However, the reason for moving from a quantitative study to two qualitative studies was to dive more deeply into their perspectives. In my future work, I hope to leverage the experiences and relationships in this study to develop a strong engagement team and advisory group to inform my post-doctoral studies and future projects in academia. However, many lessons I learned include that this work takes time to build relationships in a good way, and sustained funding. When working with young people, strong infrastructure is needed to ensure youth have the support they need to full engage in co-design efforts in a meaningful way. The lessons from study four have provided invaluable experience for me to lead future work, while respecting the

complexity involved with engaging multiple stakeholders in mHealth development, evaluating, and ongoing innovation.

Lastly, applying the CFIR allowed for a deeper understanding of the factors influencing successful mHealth implementation, facilitating the creation of more sustainable and impactful services over time, and addressing the ever-changing needs of youth. In essence, this approach bridges the gap between theoretical knowledge and practical application, fostering the development of mHealth tools that are both effective and tailored to real-world needs. For a new scholar, the CFIR provided a strong framework to help organize the knowledge from multiple perspectives. However, I recognized that the CFIR itself has not been designed by youth or other mHealth stakeholders. Future iterations of this model may be needed to guide youth mHealth implementation research, practice, and policy.

In the practical domain, this dissertation offers guidance to design, develop, implement, and sustain mHealth interventions within IYS settings. Insights coming from youth, service providers, and nonclinical staff identified facilitators and barriers to mHealth adoption and emphasized the importance of individual lived experiences throughout. This comprehensive approach (using reviews of literature, quantitative and qualitative exploration of data) underscores the importance of considering individual lived experiences, ensuring that mHealth interventions are not only technically sound, but

also resonate with and are accessible to the youth they aim to serve over time. Ultimately, these insights help design more inclusive, user-centred interventions that are more likely to be adopted, sustained, and deliver meaningful impact in the lives of diverse youth populations.

This dissertation also demonstrates the benefits of hybrid service delivery models and further highlights the need for adaptable and scalable solutions to meet diverse preferences and circumstances in a real-life setting. This is important because it underscores the value of hybrid service delivery models, which combine in-person, virtual, and other modalities to offer flexibility and accessibility for youth. By demonstrating the benefits of such models, the dissertation highlights the need for adaptable and scalable solutions that can cater to the diverse preferences and circumstances of youth in real-life settings. In an increasingly digital world, hybrid models allow for a more personalized approach, ensuring that youth have access to the care they need, regardless of geographical, social, or technological barriers. This flexibility not only improves service accessibility but also increases the likelihood of positive outcomes by accommodating the varying needs and preferences of different youth populations.

Finally, from a policy perspective, this dissertation highlights the urgent need for a standardized framework to regulate mHealth services and the engagement processes in

their design, implementation, and evaluation. The findings spotlight disparities in access and engagement, particularly among marginalized populations, calling for enforced equitable resource allocation and inclusive practices in both research and implementation. Policymakers are urged to prioritize youth engagement in decision-making processes, and to support initiatives that enhance the sustainability and safety of mHealth tools. By highlighting disparities in access and engagement, particularly among marginalized populations, the dissertation calls for more equitable resource allocation and inclusive practices in both research and service delivery. These insights are crucial for policymakers to understand the systemic barriers that prevent equal access to mHealth interventions. Prioritizing youth engagement in decision-making processes ensures that interventions are designed with the needs and preferences of young people at the forefront. Additionally, supporting initiatives that promote the sustainability and safety of mHealth tools is vital for ensuring long-term success and safeguarding the well-being of users. This call to action can guide the development of policies that promote equity, inclusivity, and effectiveness in mHealth services, ultimately enhancing their impact on youth populations.

Based on the collective findings in my thesis, I recommend future research prioritize the following areas.

First, I recommend that future mHealth service development processes be expanded, with particular emphasis on the pre-implementation phase. It is essential that this stage include a clear conceptualization of youth engagement and the establishment of a comprehensive training plan to ensure that youth understand both their role and the significance of their contributions. Researchers and developers should work to define what constitutes a safe and supportive environment for the target audience, ensuring that the process avoids tokenism. Additionally, it is crucial to establish frameworks for collaboration and set realistic expectations for both youth participants and stakeholders. By fostering a shared understanding and building trust from the outset, the pre-implementation stage can create a solid foundation for meaningful and sustainable engagement and facilitate the successful integration of youth perspectives into mHealth initiatives.

I recommend further investigation into equity-focused mHealth solutions that prioritize the engagement of less vocal, equity-deserving, and underserved youth populations. Future research should build upon the factors identified in this dissertation, such as limited internet connectivity, language barriers, and cultural differences in health-seeking behaviors, with particular attention to nontraditional healing practices among Indigenous groups. Researchers should also explore strategies for adapting interventions to address the unique needs of diverse groups, including minoritized youth,

2SLGBTQIA+ populations, and those residing in rural or resource-limited areas. Future efforts must ensure that mHealth technologies are not only accessible, but are also inclusive, culturally sensitive, and tailored to the specific contexts of these communities, thereby enhancing their potential to reduce health disparities.

Finally, I recommend establishing an iterative learning health system (LHS) to support the implementation, evaluation, and continuous improvement of mHealth services. This system would connect various engagement partners, coordinate resources, provide guidance, and promote ongoing learning and knowledge sharing. Such an approach, in practical settings such as IYS, is particularly important in mHealth development, which often involves collaborating with external technology teams outside the health system, as well as additional efforts to facilitate the mobilization and integration of knowledge across different sectors. As one participant in Study 3 noted, “We want to wrap technology around our problem, not the problem around technology. (*Alex, nonclinical staff*)”

Collaborative mHealth efforts in youth mHealth must prioritize addressing the core issues directly, rather than confining solutions within technological limitations. My studies have revealed that the problems identified by youth are often the last to be heard or adequately addressed. As both health issues and technological advancements continue to evolve, an iterative LHS that centres the voices of youth will provide the flexibility

necessary for mHealth solutions to adapt and effectively address emerging challenges.

This approach aligns with the concept of an LHS where "science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process and new knowledge captured as an integral by-product of the delivery experience [p. 136]."²⁴² An established LHS would generate and apply evidence to support collaborative decision-making among mHealth stakeholders, refining services to meet the dynamic needs of youth and facilitating engagement as an extension of healthcare services. It would ensure the continued innovation of mHealth solutions in youth settings, foster high-quality youth engagement, establish safe environments, and contribute to the development of value-creating strategies in youth healthcare.

Moreover, the significance of establishing an LHS extends beyond the current mHealth landscape. Despite the growing interest in the role of artificial intelligence in mental health services, it remains an underexplored tool. The iterative process inherent in an LHS could be leveraged to fully comprehend the potential of emerging technologies in various sectors, address the unique challenges they present, and ensure their ethical and effective implementation in supporting the diverse mental health needs of youth.

7.3 Limitations

I recognize that there are limitations to this dissertation. Data collection for my Chapters 4–6 took place in only British Columbia (BC), and therefore, results may not be generalizable. I recruited from IYS centres, which represent the group of people already receiving care. The longitudinal data covered over 4 years (2020–2023), which might not be sufficient to capture longer-term effects or evolving trends in technology and user behaviours. For qualitative interviews, other critical stakeholders (e.g., policymakers, school educators, and decision-makers) might not be adequately represented, affecting the comprehensiveness of the perspectives.

I recognize that I may bring subjective perspectives, shaped by my passion for the topic. My positionality, as a researcher committed to advancing equitable access to mental health care, influenced how I approached each stage of the dissertation, including topic selection, methodological choices, and interpretation of findings. Rather than viewing these influences solely as sources of bias, I acknowledged how they shaped the research while minimizing their impact on the credibility of the results. Throughout this study, I consciously engaged in reflexivity to acknowledge how my background and experiences may have influenced the research process. My research experience in lower-resourced settings made me aware of the dual nature of mHealth, my multicultural background informed my understanding of context-based and localized tailored youth

service. To ensure these perspectives did not unduly shape the findings, I prioritized participant voices, used note-taking, members checking and peer debriefing, and critically reflected on how themes emerged.

To help with the process, I have surrounded myself with a strong team and thesis committee to manage my bias and ensure the findings reflect the needs of youth and other stakeholders who participated in the research. Recognizing the influence of personal passion demonstrates my self-awareness and a commitment to maintaining a balanced and impartial perspective. The involvement of a strong team at Foundry Central office and a thesis committee helps mitigate this bias by providing diverse viewpoints and oversight, ensuring that the findings are not only reflective of my interests but also of the broader needs and experiences of youth and other stakeholders considered in this dissertation. These steps helped maintain transparency and rigor while amplifying youth and stakeholder perspectives. This reflexive approach strengthens the credibility of the research and enhances the validity of its conclusions, making the results more representative and trustworthy.

One final and notable limitation was a lack of a youth advisory committee for my dissertation. I learned this limitation as my results emerged. Due to COVID-19, much of my early studies took place at home outside of Canada. The lessons I learned about the value of youth engagement were deeply personal and enlightening. I realized that a

rigorous plan for youth engagement in my research process could have impacted the depth and relevance of the findings. The absence of a youth advisory committee for my thesis meant that youth perspectives were not formally integrated into the early research design, which may have led to gaps in understanding or overlooked priorities.

Recognizing this limitation demonstrates critical self-reflection and an openness to learning from the research process. This acknowledgment also underscores the importance of youth involvement in shaping my future research, ensuring that their voices are central to the development, implementation, and evaluation of interventions that affect them. It provides valuable insight for my future studies, emphasizing the need to establish such advisory committees to better align research outcomes with the needs and experiences of youth populations.

7.4 Conclusion

In conclusion, this dissertation makes a significant contribution to the field of youth mental health by exploring the integration of mHealth technologies to improve access to mental health services. Through a comprehensive multi-methods approach, including a scoping review, quantitative data analysis, and qualitative research, the studies identified key barriers, facilitators, and strategies for the effective and sustainable implementation of mHealth interventions. The findings provide a solid foundation for future research, practice, and policy development aimed at bridging gaps in youth mental

health care. As youth mental health remains an urgent concern, this dissertation's insights have the potential to drive impactful advancements in service delivery, using technology to address the evolving needs of youth, particularly within the context of IYS in British Columbia. Ultimately, this work serves as a critical step in advancing innovative, accessible, and sustainable solutions to improve mental health outcomes for youth, offering valuable guidance for future efforts in this vital area.

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Experienziellen Ansatz für hochgradig aggressive Jugendliche / Alcanzando lo
Inalcanzable: Ejemplos del caso de un enfoque centrado en el cliente y experiencial para
la juventud altamente agresiva / Atteindre l’Inatteignable: Cas Concrets d’une Approche
Centrée-sur-la Personne Expérientielle avec des Jeunes très Agressifs / Alcançando o
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Appendix A

Sample Literature Search Sheet

Embase <2016 to 2022 February 07>

1 telemedicine/ or telerehabilitation/ 37099

2 mobile application/ 16795

3 (mhealth or telemedicine or telehealth or mobile health or ehealth or electronic health).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] 105313

4 1 or 2 or 3 118417

5 adolescent/ 1646536

6 (teen* or adolescent* or youth* or young adult).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] 2079194

7 5 or 6 2079194

8 mental disease/ 241422

9 (anxiety or depression or eating disorder* or schizophrenia or bipolar or obsessive compulsive disorder or posttraumatic stress disorder or post traumatic stress

disorder).mp. [mp=title, abstract, heading word, drug trade name, original title, device
manufacturer, drug manufacturer, device trade name, keyword heading word, floating
subheading word, candidate term word] 1264854

10 8 or 9 1409947

11 4 and 7 and 10 1344

Appendix B

 **· F O U N D R Y ·**

**HAVE YOU USED THE FOUNDRY APP?
ARE YOU AGED 16-24?
NOW RECRUITING!**

 **Come join our 1-hour online dialogue.
We want to hear your voice!**

 **All voices are welcomed and valued!**

 **All participants will receive a
\$40 honorarium!**



CONTACT US NOW TO LEARN MORE

 Alex (Xiaoxu) Ding:  

H22- 03454 Version 2 March 6 2024

**This study is led by Dr. Skye Barbic,
Associate Professor at UBC**

The study team acknowledge that they are the uninvited guest guests working on the unceded lands across what is currently British Columbia, and recognize that they are on the stolen lands of various, strong Indigenous Nations

· FOUNDRY ·

RECRUITMENT
ONGOING

WE WANT TO HEAR YOUR VOICE

*Have you used the Foundry App?
Come join our 1-hour online dialogue!*



Who can participate?

- User of Foundry App
- Ages 16-24

Each participant will get

\$40 HONORARIUM

H22-03454

version 2 March 6 2024

To schedule or learn
more, please contact
Alex (Xiaoxu) Ding at:



ALL VOICES ARE WELCOMED AND VALUED!

This study is led by Dr. Skye Barbic, Associate Professor at UBC.

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Appendix C

Part 1. Perception of mHealth concept	
Selected example interview questions	Example prompt and elaboration
1. Are you familiar with the concept mHealth? Can you describe what exactly is mHealth and its goal?	What are some in-person service barriers can be addressed by mHealth?
2. Describe the top three best things and your three worst concerns about mHealth.	
3. Do you think or to what extent mHealth can replace traditional in-person mental health support?	Can you explain your answer based on your own experience?
Part 2. User experience of Foundry App	
1. (Perceived Usefulness) In what ways do you believe the Foundry App is helpful to youth health status and in their work/life?	If possible, can you describe a real-life situation?
2. (Perceived Ease of Use) How easy do you think it is for youth to learn and use the mHealth technology?	What is some potential difficulties youth could have while using?
3. (Attitudes) How do you feel about the Foundry app when you are using?	What are your general impressions of the app?
4. (Subjective norm) Do you feel youth would receive pressure from others when they use mHealth services?	Will it be different compared to in-person services? How did you start to use this service?
5. (Intention to use) What is your biggest concern before they schedule your first appointment using Foundry app?	What do you think is biggest barrier that stopped youth to access service?
6. (Actual system use) What was the motivation that eventually made you to use the service?	What do you think is the motivation that made youth to access service?
Part 3. Sustainability in mHealth	
1. Have you used similar products or services in the past?	How did they compare to the Foundry App?
2. What do you think are some key challenges to keep a service operating, to keep the	To makes sure the app was not released and disappear after a year.

sustainable?	
3. If you were asked to design your own sustainable mHealth product for your community or your company. List your top three tasks that you put on the priority list.	