



The App4Independence (A4i)
Evidence, Research and Data Review

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A4i App4Independence

A4i is a digital therapeutic and digital biomarker platform for severe mental illnesses (SMIs). The platform features a mobile app used by patients and a clinical portal to support care coordination by providers. A4i is a trans-diagnostic platform which has cross cutting applications across many SMIs. A4i addresses critical gaps during pivotal points in the recovery process by providing tools to improve outcomes, enhance clinician-patient engagement and identify risk of relapse.

A mobile app and web/EMR based portal, the interventions allow those who are isolated and experiencing challenges related to more complex issues (bipolar disorder, schizophrenia, other psychoses) to connect and interact in a human + machine learning moderated feed without adding burden to existing healthcare systems. The feed shows upcoming medication, social, and care reminders, peer-to-peer content and evidence-based supports.

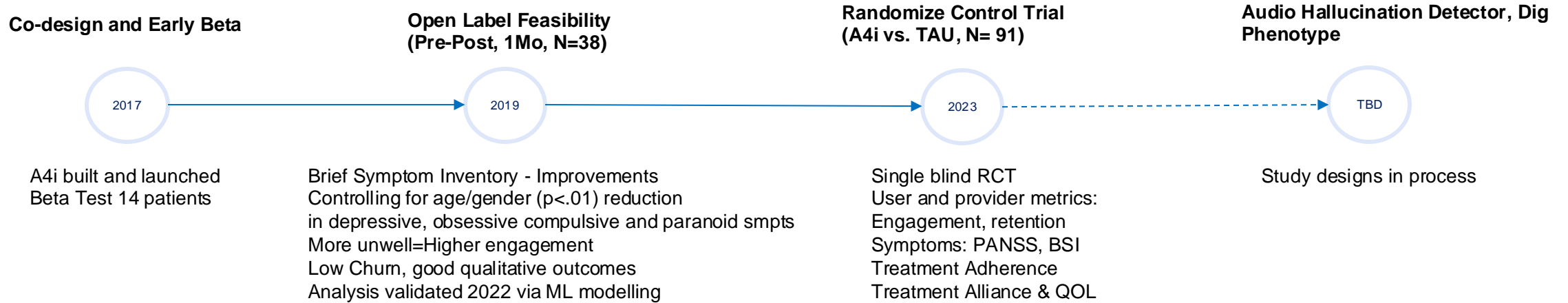
A4i provides a patent-pending ambient hallucination detector to help patients determine the difference between ambient noise and hallucinations. Other features include short diaries for patients and wellness reports that demonstrate trends in medication adherence, sleep, goal tracking, and mood. Risk data collected by the app is also reflected on a patient's profile moderated by peer-support workers, case managers and clinical therapists.

The following evidence, research and data review provides detail on clinical validations to-date, data from pilot and real-world implementations and presents a review of poster presentations, publications and conference presentations to-date.

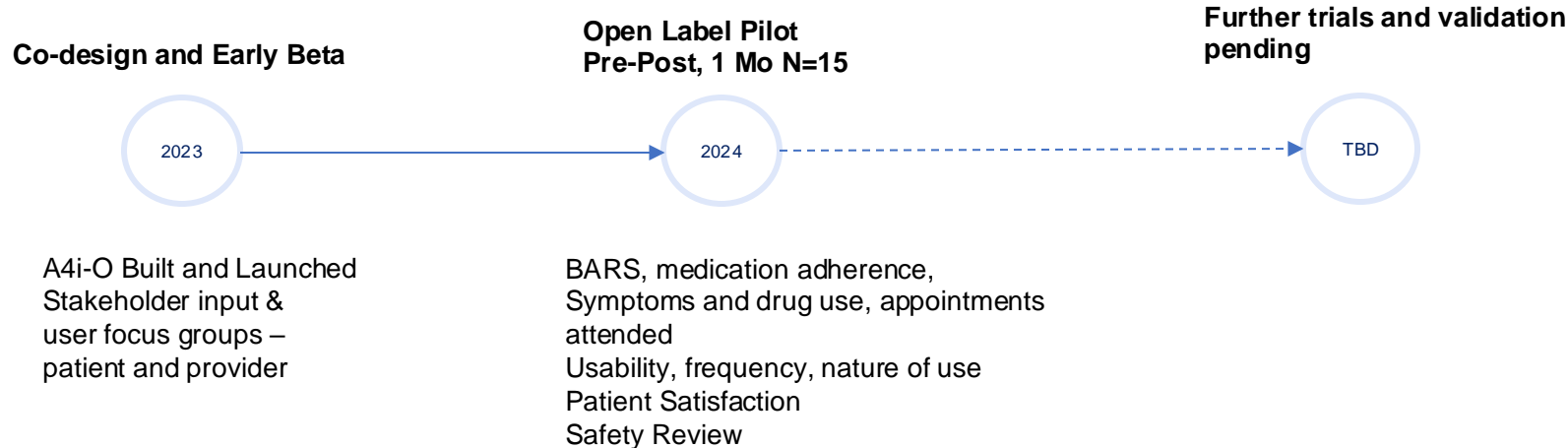


2. Trial Data Overview

A4i Schizophrenia, Psychosis



A4i-O (Opioid Use Disorder)



3. Clinical Trial Evidence & Publications

a. Open Label Feasibility Trial 2019

The focus of this study was upon the feasibility of a schizophrenia-focused mobile application: This study was completed in a large urban Canadian centre and employed pre-post assessments over a 1-month period that examined medication adherence, personal recovery, and psychiatric symptomatology. App use metrics were assessed as was qualitative feedback through semi-structured interview.

- 1 month, 38 participants, pre-post qualitative and quantitative metrics
- Engagement: 0% Research Attrition, 100% rolling retention at 7 days, 94% at 20 days, feed used 2-3 times/day
- Improvements were seen in psychoticism, depression, phobic anxiety, obsessive compulsive symptoms, paranoid ideation, and interpersonal sensitivity. Improvements were also seen in treatment adherence and engagement in personal recovery.
- Controlling for gender and age, particularly substantial improvement ($p < .01$) were seen in depressive, obsessive compulsive, and paranoid ideation subscales.
- More frequent A4i users were more depressed, had higher hostility, and more interpersonal sensitivity at baseline.
- Qualitative feedback was positive and no significant risks related to A4i use were observed.
- A subsequent re-analysis using machine learning modelling validated the above observations – published 2022

Significant **declines** in **depression** subscale ($p < .001$) **obsessive compulsive** ($p = .004$) and **paranoid ideation** subscales ($p < .001$)



Predicting symptom response and engagement in a digital intervention among individuals with schizophrenia and related psychoses.
<https://www.frontiersin.org/articles/10.3389/fpsy.2022.807116/full>



Feasibility and outcomes of a multi-function mobile health approach for the schizophrenia spectrum: App4Independence (A4i)
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0219491>

3. Clinical Trial Evidence & Publications

b. Randomized Control Trial Completed in Q3 2023 – Finalizing Publication Q4

2024

This study employs a 2-arm, randomized controlled trial design: (A4i vs. Treatment as Usual, N= 91)

This study was funded by the Canadian Institutes of Health Research.

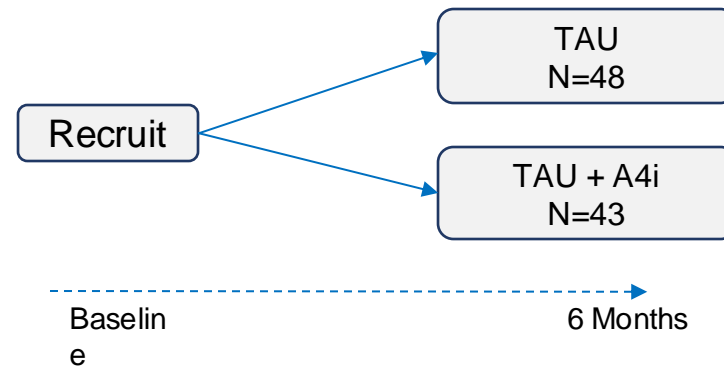
Duration of Intervention 6 Months

The design is single blind as participants will be aware of A4i exposure with the assessor blinded.

Measures: A4i engagement and retention; symptoms, treatment adherence, clinical relationship, quality of life and clinical outcomes

Clients are supported in using A4i through research staff and volunteers

Trial paper pending publication – results announced soon



- Engagement, retention
- Provider Patient Alliance STAR
- Positive and Negative Syndrome Scale (PANSS)
- Brief Symptom Inventory Evaluation (BSI)
- Treatment Adherence
- Treatment Alliance
- Heinrichs-Carpenter Quality of Life



Protocol: Examining a Digital Health Approach for Advancing Schizophrenia Illness Self-Management and Provider Engagement: Protocol for a Feasibility Trial
<https://www.researchprotocols.org/2021/1/e24736/>



4. Real World Pilot Implementation Data

a. Riverside University Health System Clinics – California US

Headquartered in Riverside County California, A4i initiated a commercial pilot with the Riverside University Health System (RUHS) Behavioral Unit. The program utilizes Certified Peer Support Specialists to monitor and engage users (clients) on the A4i portal and platform.

Started in September 1st of 2021, users engage with A4i for a structured 6 month engagement period. The project is funded by the California Mental Health Services Authority.

Since 2021, the pilot has been expanded and extended to 9 clinical sites on an ongoing basis.

	Dis-Satisfaction Decreased Ratings 1-4			Satisfaction Increased Ratings 7-10		
	Pre	Post	% Decrease	Pre	Post	% Increase
How satisfied are you with your life as a whole?	40.5%	21.6%	-18.9%	29.7%	35.1%	+5.4%
How satisfied are you with feeling part of your community?	40.5%	24.3%	-16.2%	27%	48.6%	+21.6%
How satisfied are you with your personal relationships?	43.2%	16.2%	-27.0%	35.1%	62.2%	+27.1%

Quality of Life - A 9-item questionnaire used to collect general quality of life, well being, and sense of social connectedness.

	Satisfaction Increased Ratings 4-6		
	Pre	Post	% Increase
How do you feel about the amount of meaningful activity (e.g. work, school, volunteer, leisure) in your life ?	18.9%	40.5%	+21.6%
How do you feel about the amount of time you spend with other people?	18.9%	37.8%	+18.9%
How do you feel about the amount of friendship in your life?	21.6%	45.9%	+24.3%

Quality of Life - Items Meaningful Activity Relationships Scale 1-Unhappy Terrible to 6-Delighted

Surveys administered three (3) times: Pre, 3-months, and 6 month completion

4. Real World Pilot Implementation Data

a. Riverside University Health System Clinics – California US

- This plot observes weekly active users for RUHS.
- Summarizes the % of patients who engaged with the app on a weekly basis.
- The week over week engagement is high with an average of roughly 70%.

Frequency of use of A4i features



Social Feed 43%



Check-Ins 34%



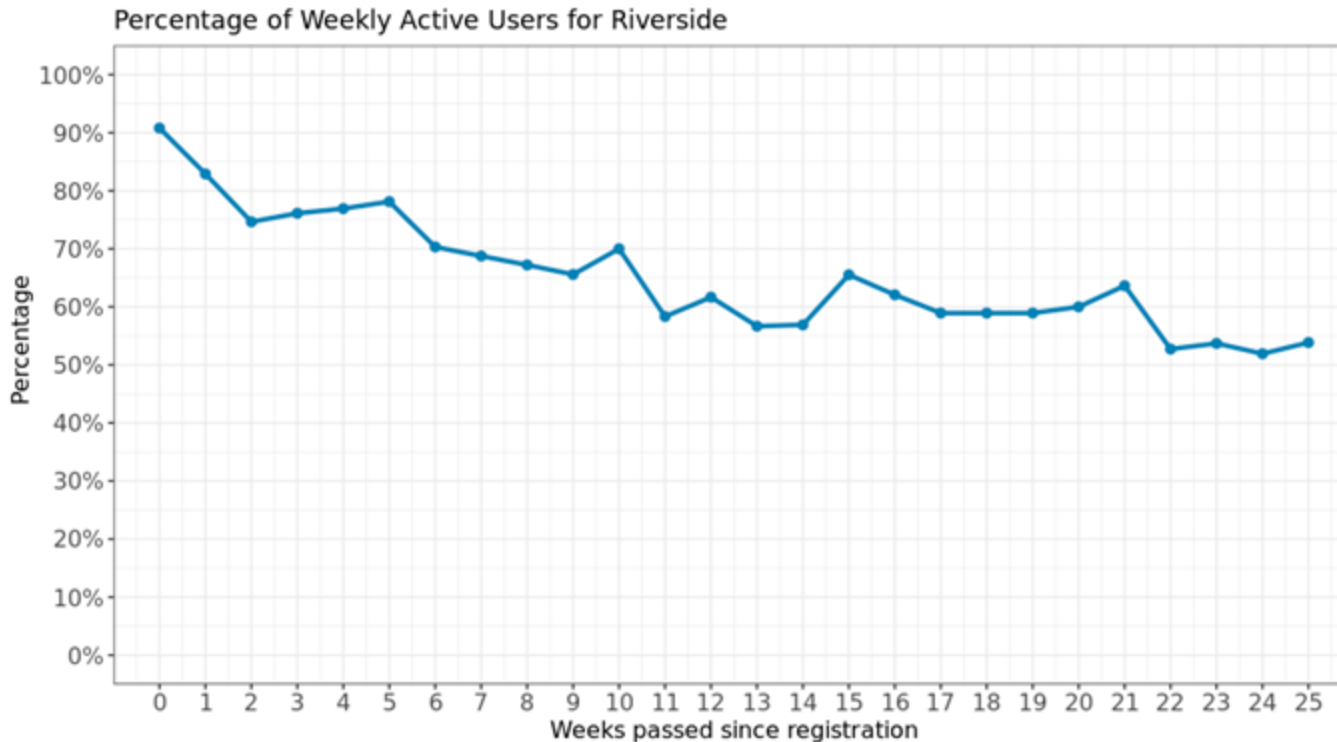
Ambient Sound Detector 2%



Self Reports 1%

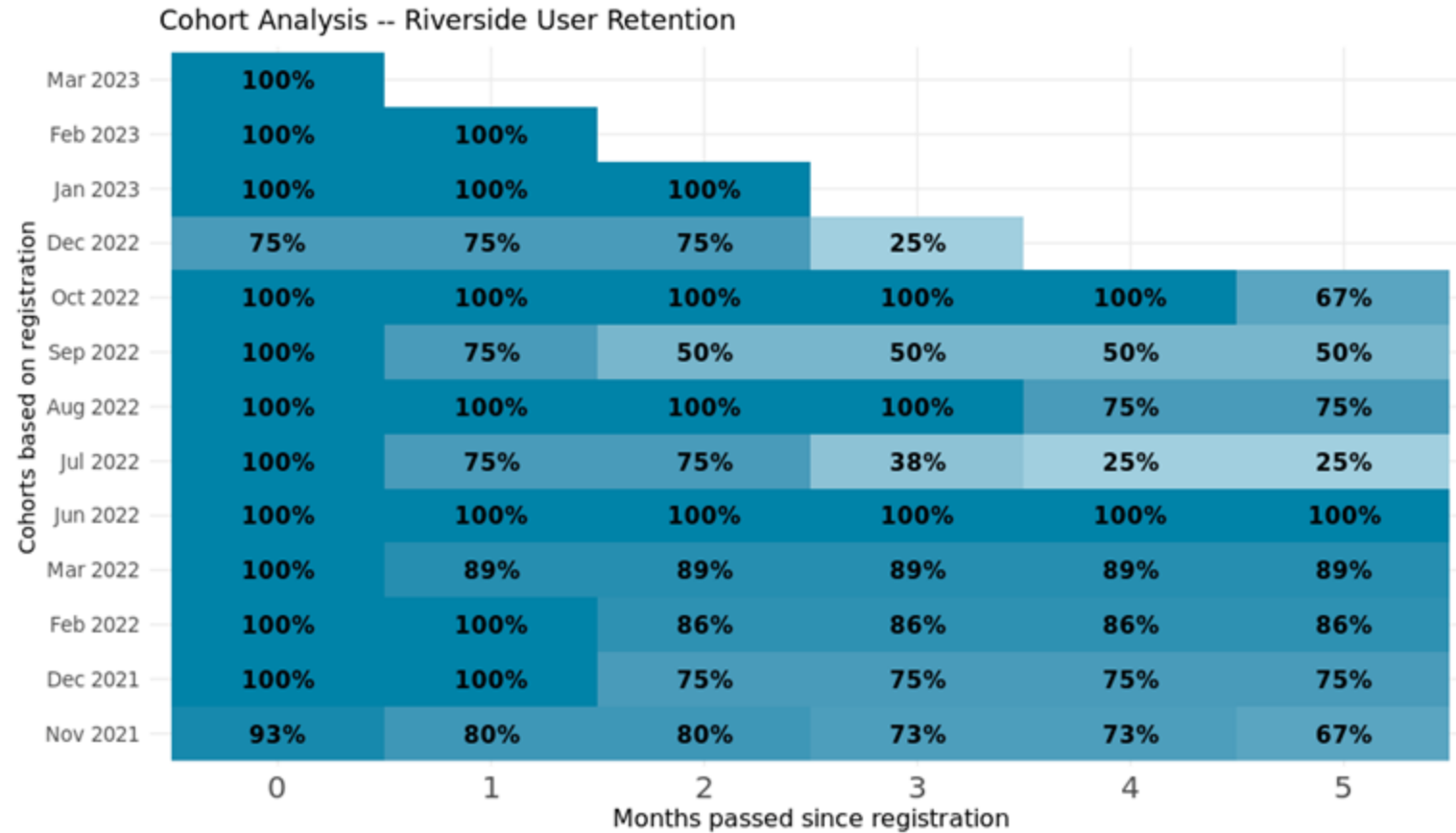
- 91.9%** enjoyed using A4i
- 91.9%** thought A4i is easy to use
- 86.5%** found A4i useful in their daily lives
- 83.8%** thought it is easy to find the information they need in A4i
- 78.4%** thought A4i met their wellness needs
- 67.6%** thought A4i rarely crashed or caused problems
- 94.6%** would recommend A4i
- 89.2%** would continue to use A4i if given the opportunity
- 89.2%** thought the information on A4i is credible and trustworthy
- 81.1%** thought it is easy to navigate within A4i
- 75.6%** thought using A4i improved their mental health

Summary of User Experience Survey after 3-Months and 6-Months in the Pilot A4i User Experience Survey. % reflect “Agreed” or “Strongly Agreed” responses to survey item statements.



4. Real World Pilot Implementation Data

a. Riverside University Health System Clinics – California US



- Participants enrolled in the same month are grouped into cohorts and analyzed over the 6-month trial.
- Retention indicates if a user has returned and engaged with the app in each month.
- For example, 89% of participants that enrolled in Mar-2022 are returning and engaging with the app 2 months later.
- As of March 2023, 8 cohorts (Nov 2021 to Sept 2023) have completed the trials with an average retention of 84%.
- Overall, A4i is consistently and continuously used with emphasis in the first 3 months after enrollment.

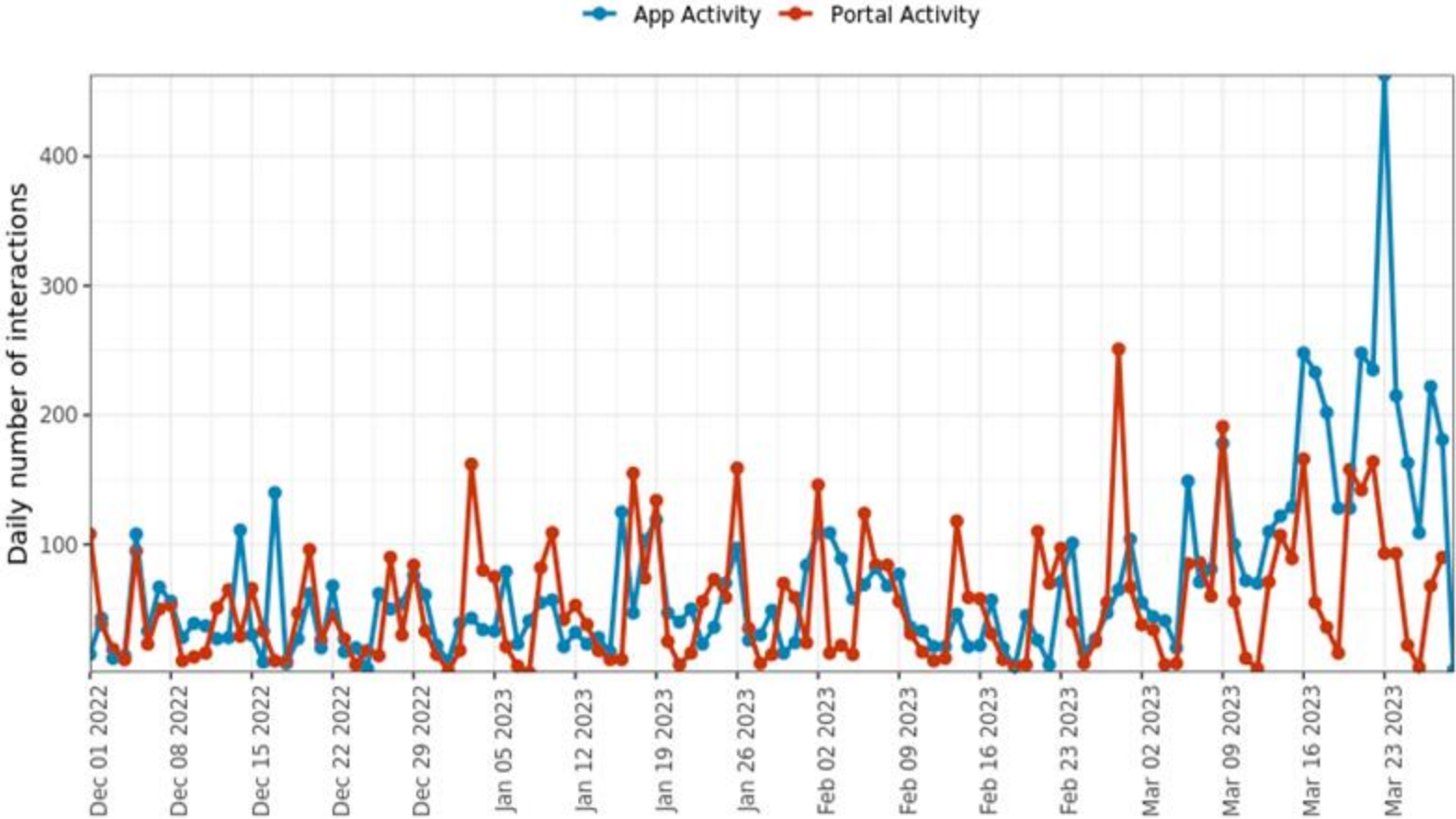
4. Real World Pilot Implementation Data

a. Riverside University Health System Clinics – California US

Displays the daily activities from patients (app) and peer support workers (portal) from Dec 2022 to March 2023.

Note the positive correlation as the app and portal activity move in tandem.

High engagement in the portal corresponds to high engagement in the app



4. Real World Pilot Implementation Data

b. CAMH Outpatient Comprehensive Treatment Clinics (Toronto, Canada) (Pilot start: Nov 2021 – Dec 2023)

A4i has been gathering clinician feedback on the usability, utility and efficacy of A4i in real world settings. Initiated at the Centre for Addiction and Mental Health (CAMH), this pilot is active with a focus on real-world implementation in a setting with competing priorities and high caseloads.

Recruitment Process: Snowball sampling and rolling recruitment across 3 outpatient sites (DT west, east, central)

Evaluation Process: Mixed methods evaluation, consisting of qualitative interviews and quantitative user experience surveys

Onboarded Clients: 9

Active Clients: 5

Periodically Engaged Clients: 4

Onboarded Clinicians: 9

Active Clinicians: 6

Dropped-out Clinicians: 3

Clinician

Backgrounds:

- 1 Recreation Therapist
- 2 Occupational Therapists
- 1 Registered Practical Nurse
- 1 Psychologist Intern
- 2 Psychologists
- 1 Social Worker

Clinician feedback on A4i

- Clinicians appreciated the visually appealing UI and intuitive/easy to use nature of the app
- Animal emojis, usernames, and newsfeed allowed clients to freely express themselves
- Access to reports and visualized data was useful for both clients and clinicians
- Reminders & notes were useful in having clients complete CBT homework (i.e., practicing coping skills like grounding techniques and deep breathing, jotting down thoughts, etc.)
- Need to ensure management is appropriately engaged to support identifying an appropriate way to implement digital health tools into clinical workflows without added burden.

4. Real World Pilot Implementation Data

c. The Royal Mental Health Care Centre (Ottawa, Canada)

Launched Spring 2023 Funded by the Ontario Bioscience Innovation Organization (OBIO) Early Adopter Health Network for Pre-Procurement activities.

Key metrics: Engagement and business case economic analysis (e.g., optimization of appointment attendance)
Piloting peer supports as digital navigators

Implementation site: Large outpatient care setting

Description: This pilot assesses the feasibility of integrating the A4i app and clinical portal into clinical practice. The project will allow the team to assess the impact of the app broadly through surveys (breadth) and generate a more nuanced understanding of the client and clinician experience monthly status report meetings (depth). These two methods can be used to understand the early impacts of the program and to identify what metrics can be used to signal success.

Measures: Challenges during recruitment and onboarding, number of technical questions or challenges, survey participation, number of times A4i aided with appointment attendance, usefulness data from survey and team meetings, engagement within all sections of the app, number of times clinical portal resulted in a patient check-in; usefulness of A4i for facilitating patient-client communication ; number of times A4i engagement resulted in patient check-in ; number of times A4i aided with medication adherence; number of deferred appointments as a result of A4i usage; frequency of use of A4i for CBT homework

5. Conference Presentations Posters and Papers

Conference Abstracts

- An Exploration of the Digital Health Technologies for Opioid Use Disorder: A Systematic Review. CPA 85th Annual National Convention. July 19, 2024.
- The Role of Digital Health Strategies in the Treatment of Complex Mental Health Conditions and Addictions: A Conversation Session. CPA 85th Annual National Convention. July 19, 2024.
- Co-Design of a Digital Health Tool for Use by Individuals with Opioid Use Disorder: App4Independence (A4i-O). CPA 85th Annual National Convention. July 19, 2024.
- A Review of Commercially Available Digital Health Technologies for Opioid Use Disorder. CPA 84th Annual National Convention. June 23, 2023.
- Implementation of a Digital Health Platform to Support the Schizophrenia and Psychosis Recovery Process in Three Different Clinical Contexts. CPA 84th Annual National Convention. June 23, 2023.
- Supporting Mental Health Recovery Through a Digital Platform: Multisite Implementation. eHealth 2023 Conference and Tradeshow. May 28-30, 2023
- Current digital health technologies for treating Opioid Use Disorders. CPA 84th Annual National Convention. June 23, 2023.
- Co-Design in Digital Mental Health: Empowering or Performative? CPA 84th Annual National Convention. June 23, 2023.
- Current digital health technologies for treating Opioid Use Disorder. eHealth 2023 Conference and Tradeshow. May 28-30, 2023
- Implementation of a digital platform for schizophrenia across three different contexts. Wales and CAMH Symposium: Digital Mental Health from Policy to Practice. Nov 16, 2022
- A4i at CAMH: Supporting patient recovery through implementation of a digital platform into clinical practice. CAMH Digital Health Symposium. Feb 1, 2022.

Publications

- Leveraging Personal Technologies in the Treatment of Schizophrenia Spectrum Disorders: A Scoping Review. JMIR Ment Health. 2024.
- Co-Design of a Digital Health Tool for Use by Individuals with Opioid Use Disorder: App4Independence (A4i-O). Substance Use and Addiction Journal. 2024.
- Predicting symptom response and engagement in a digital intervention among individuals with schizophrenia and related psychoses. Frontiers in Psychiatry. 2022.
- Examining a Digital Health Approach for Advancing Schizophrenia Illness Self-Management and Provide Engagement: Protocol for a Feasibility Trial. JIMR. 2021.
- Is there a clinically relevant, publicly accessible app for that? Exploring the clinical relevance and availability of mobile apps for schizophrenia and psychosis. Schizophrenia Research. 2021.
- Feasibility and Outcomes of a Multi-Function Mobile Health Approach for the Schizophrenia Spectrum: App4Independence. PLOS ONE..2019.

Presentations

- App for Independence: A Feasibility Randomized Controlled Trial of a Digital Health Tool for the Schizophrenia Spectrum. University of Toronto Psychiatry Research Day. June 2024.
- Integrating Mobile Apps into Mental Health Treatment & Care. CNIA Conference. June 14 2023.
- Looking Forward: An Introduction to Digital Mental Health. Boehringer Ingelheim Schizophrenia International Research Society Symposium. May 11 2023
- Integrating Digital Mental Health Tools into Clinical Practice. Psychiatry Grand Rounds. Women's College Hospital. May 5 2023
- App4Independence (A4i) Mobile App Pilot. A Digital Support Path for Emotional Wellness. RUHS DEI Grand Rounds. February 14th 2023.
- Educating Individuals with Schizophrenia Spectrum Disorders and Clinicians on the Use of a Digital Health Platform (Donald Wąsyleński Education Day Conference, Feb 2023)
- The Digital Mental Health Landscape in the Treatment of Schizophrenia Spectrum Disorders: A Systematic Scoping Review (Schizophrenia International Research Society Conference, Dec 2022)
- Optimizing a Novel Digital Health Platform for Schizophrenia-Spectrum Populations: From Trials, Patents and Concepts to “real world “
- Clinical Implementation in a California Health System. ISRII. September 2022.
- Integrating Digital Mental Health Tools into Clinical Practice. Complex Care and Recovery Leadership Meeting. CAMH. Aug 2 2022
- Research Engagement of Psychosis Populations During the Global Pandemic: Learnings from a Digital Health Virtual Randomized Control Trial (Canadian Psychological Association Annual National Convention, June 2022)
- Integrating Digital Mental Health Tools into Clinical Practice. Technology Integration Working Group. CAMH. April 27 2022
- Integrating Digital Mental Health Tools into Clinical Practice, presented at the Complex Care and Recovery Leadership Meeting (Aug 2022), and the Technology Integration Working Group (April 2022)
- Shaping the Future of Virtual Mental Health Care (Panelist - Virtual Mental Health Care Leadership Series, March 2021)
- Technology-Driven Supports for People with Psychosis (Keynote - EPION Annual Conference, Nov 2019)
- From Collaboration to Co-Commercialized Digital Engagement in Complex Behavioral Health: A Provider-Innovator Partnership (Stanford Medicine X Annual Conference, Sept 2019)
- Using mHealth to Support Individuals with Schizophrenia and Predict Relapse (eHealth Canada Annual Meeting, May 2019)
- From Problem to Prototype: Building a Digital Health Approach to Schizophrenia (Neuroinformatics and Big Data in Mental Health, Jan 2019)
- Reaching Complex Mental Health Populations with Digital Health Solutions: Serving the Underserved (BIO International Convention, June 2018)
- Commercialization Story – Identifying Relapse Risk and Improving Lives of Individuals with Schizophrenia Through mHealth Technology (Apps for Health Annual Conference, April 2018)

6. Data Science Summary



Feature Engineering for Predictive Risk Detection:

A4i is collecting and engineering for application feature usage i.e. feed refreshes, app feature utilization and frequency of use and phone/device characteristics.

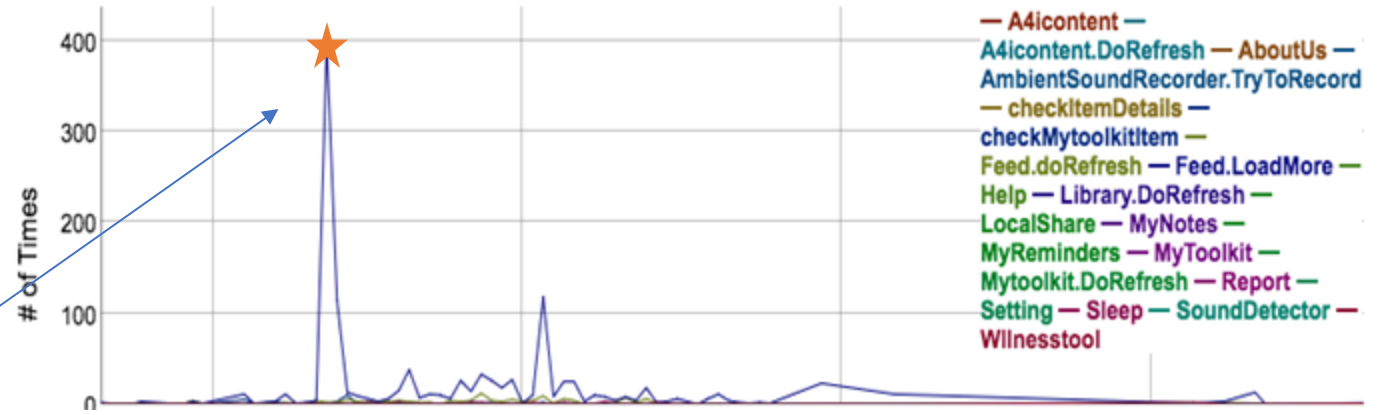
Data collection is underway for proactive risk detection and reporting while feature engineering to develop early identification of objective/subjective early predictors of non-engagement/clinical trial drop-off, non adherence, relapse and readmission.

Refresh frequency example illustrated.

Detecting Sentiments and Emotions from Textual Data

- Developed and tested early text classification model to identify 'risk' from patient feed text and patient notes-to-clinician
- Tested 2 models (VADER & BERT) to predict sentiment and emotions
- Demonstrated models of detecting negative statements
- Validating utility of 'risk' detection within social feed and notes-to-my-clinician A4i features

Cumulative Actions from all Users

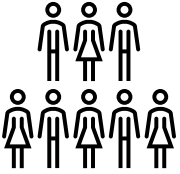
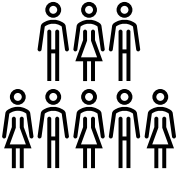
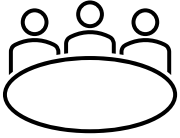
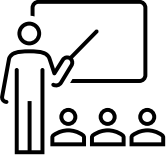
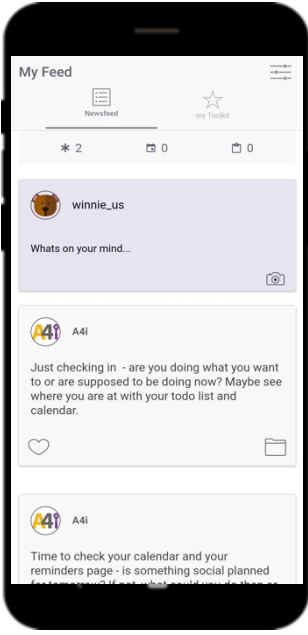


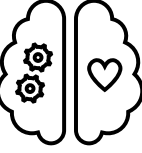
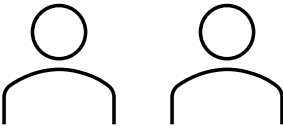
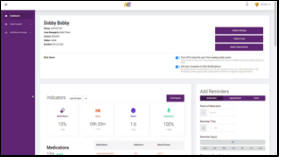




Frequency of Social Feed Refresh Function as Indicator of Risk

ORIGINAL TEXT FROM PATIENT	ACTION BY LIVE CASE MANAGER	CASE MGR DECLINE REASON	HOW THE MACHINE SCORED SENTIMENT (SCORE)	EMOTION (PROBABILITY)
I think the LA Sierra TANF office of Social Services is so full of it if they didn't want to help people and children they should have chosen a better job. What's crazy is you get a Hispanic worker racists against her own race. It's a SHAME	Declined Post	Negativity, Identifiable	Negative (-0.82)	Surprise (0.30), Anger (0.23)
I am so overwhelmed with my new diagnosis and change of medication. I am so anxious and uneasy . I can't seem to get out of this funk of being being numb .	Declined Post	Help	Negative (-0.74)	Fear (0.95) Joy (0.01)
I had a good time at the Angeles game last night, it was great for my mental health now I'm off to my DBT group everyone have a great day	Approved Post	NA	Positive (+0.90)	Joy (0.99) Sadness (0.00)
Wow its been a long week loving the new job having fun learning to show the compassion i have from within.	Approved Post	NA	Positive (+0.93)	Joy (0.99) Surprise (0.019)

Natural Language Processing RISK detection in Social Feed

6. A4i-O Development

Co-Design	Beta-Version	Open Label Pilot
<p style="text-align: center;">Participants</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Lived experts with OUD</p> </div> <div style="text-align: center;">  <p>Care providers with OUD</p> </div> </div> <p style="text-align: center;">Methods</p> <p style="text-align: center;">Series of three 90-minute focus group interviews to inform the development of the app</p> <div style="text-align: center;">  </div> <p style="text-align: center;">Results</p> <p style="text-align: center;">Directions included creating a safe space, curating resources for OUD as a multifaceted condition, and being mindful of barriers to implementation</p>	<p style="text-align: center;">A4i-O designed and launched</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <div style="display: flex; justify-content: space-around; align-items: center; margin-top: 20px;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p style="text-align: center;">Features include:</p> <p style="text-align: center;">Educational Content Feed Medication and Appointment Tracking Well-being Check-ins OUD Specific Tools</p>	<p style="text-align: center;">Participants</p> <div style="text-align: center;">  <p style="text-align: center;">Individuals with OUD and their care provider</p> </div> <p style="text-align: center;">Methods</p> <p style="text-align: center;">Access to the app and clinician portal for a 1-month period Robust qualitative data collected</p> <div style="display: flex; justify-content: space-around; align-items: center; margin-top: 20px;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p style="text-align: center;">Results Pending</p> <div style="text-align: center; margin-top: 20px;">  </div>



Thank you

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Executive Summary Download: <https://mtxt.io/A4iExecSummary>

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