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New study demonstrates MindBeacon's Therapist Assisted iCBT is a highly effective treatment for people with clinical levels of depression and comorbid anxiety.

Over the past 2 years more than 5,000 clients who completed the MindBeacon program experienced reliable symptom improvement.

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Highlights

- Conducted a comprehensive analysis of two years of data, representing 12,839 people who consented to treatment for symptoms of depression.
- Treated thousands of people with clinically severe levels of depression, and thousands of people with clinically severe co-morbid anxiety.
- 77% of clients start treatment with clinical level symptoms (a score of 10 or more on the PHQ9) of depression; 56% are suffering from clinical levels of both depression and anxiety symptoms (a score of 8 or more on the GAD7).
- On average, clients start treatment with a depression symptom score in the moderately severe range (16) and finish with a score in the moderate depression range (10).
- Initial symptoms, amount of treatment readings and frequency of engagement all contribute to symptom improvement.
- More than half of clients with clinically severe symptoms experience reliable symptom improvement.
    - This compares very favourably with other forms of treatment and TAiCBT studies and experience in other jurisdictions.
- Clients with a range of engagement patterns can benefit from TAiCBT, clients who stretch out engagement over 4 or more weeks experience optimal results.
    - This is also consistent with past research showing that increasing engagement increases the number of clients achieving reliable clinical change.

Introduction

Therapist assisted digital CBT (TAiCBT) has been shown to be effective for the treatment of symptoms of depression and anxiety, with longer treatment durations and greater treatment engagement being primary drivers of reliable clinical change[1](Andrews et al., 2018). MindBeacon provides a TAiCBT program to residents of Canada, and between 2020 and 2021, the number of people seeking help from MindBeacon more than doubled, with a large percentage of those people having symptoms that meet or exceed the level to be considered a clinical case[2]. In the general population, the lifetime prevalence of comorbid anxiety and depression is high (45.7% of the population), and many people experience symptoms of both disorders at the same time (Kessler et al., 2015). Given the scale of the mental health needs of the population and the increased utilization of MindBeacon TAiCBT, we wanted to determine the effectiveness of our depression protocol for people with symptoms of depression and people with symptoms of both depression and anxiety.

In addition to establishing our treatment effectiveness, our large, community-based dataset enabled us to explore the relationship between moderating factors (e.g., client characteristics), mediating factors (e.g., patterns of client and therapist engagement) and symptom reduction. Several previous studies have explored the relationship between moderators of symptom reduction (Etzelmueller et al., 2020; Karyotaki et al., 2017, 2021) but there has not been as much research looking at patterns of engagement as it relates to reliable clinical change, and many studies have relatively small sample sizes limiting the power and generalizability of findings. It is known that greater exposure to treatment is associated with greater outcomes (Hilvert-Bruce et al., 2012), but in many iCBT programs, including MindBeacon's TAiCBT, clients can choose the pace of their engagement. Clients can engage in one or more concentrated sessions or could spread activity consistently over time. Given this client-centred flexibility, we wanted to determine if there is a significant difference in outcomes for different patterns of engagement.

This study is a comprehensive analysis of data for all clients assigned to the MindBeacon depression protocol between January 2020 and December 2021. During this time, the government of Ontario selected MindBeacon to provide free mental health support province-wide in response to the COVID-19 pandemic. The sample is representative of the diverse population of the province of Ontario, Canada. Our results show that a significant percentage of clients achieve reliable clinical change, and that the effect size of treatment on our sample is large and significant.

Methods

Treatment. Treatment consisted of therapist-guided readings and practical applications of concepts via worksheets, released to the client over the course of up to 12 weeks. Clients had access to their therapists

[1] Achieving reliable clinical change (RCC) is determined by the reliable clinical change index found in the IAPT (Adult Improving Access to Psychological Therapies) manual. Each outcome measure has a point value associated with achieving RCC. IAPT is the UK national framework for psychotherapy.

[2] Caseness is an indicator of symptom severity under the IAPT framework. When a person's symptom score exceeds the accepted clinical threshold for the relevant measure of symptoms, they have symptoms that warrant clinical intervention.

for the 12 active program weeks, after which they retained access to the materials and their message history for an additional 40 weeks.

Depression Program Content. The program was developed based on current research and best-practice guidelines for Internet-based Cognitive-Behavioral Therapy treatment of depression. Content was separated into several 'playlists' comprised of readings and worksheets on relevant concepts and skills. The following is an example of the playlists released in a standard program flow: (1) psychoeducation about depression, psychoeducation about CBT, goal setting; (2) behavioral activation; (3) identifying and rating emotions, identifying unhelpful thinking patterns; (4) challenging unhelpful thinking patterns; (5) identifying core beliefs, downward arrow technique; (6) challenging core beliefs; (7) problem-solving; and (8) maintaining wellness and preventing relapse.

Tailoring. The program flow varied among clients, as therapists tailored the quantity, pace, and order of materials released to the needs of each individual client. Furthermore, the content itself varied among clients, as therapists could choose to omit some materials or add supplementary materials – for example, to address co-morbid secondary concerns such as anxiety, sleep problems, or other issues.

Therapist Role. Over the course of active treatment, the therapist's role involved reviewing completed materials and outcome measures and using clinical judgement to tailor program content and coach clients through the content – prompting, clarifying, trouble-shooting – via asynchronous online messaging. Clients were able to solicit guidance and ask content-related questions at any time, with therapists responding within two business days. Therapists were able to draw from an eLibrary of standardized messages to address client queries or could tailor responses to individual clients as needed.

Participants. Clients resided in Canada and accessed the program via multiple referral sources, including self-referral, employment assistance programs, and referral by other health professionals. Depending on their insurance status and province of residence, clients paid the full fee for the program ($525) or were able to have the cost partially or fully subsidized.

Informed Consent. Clients provided informed consent at three points in the process of starting the depression program: upon creation of a user account on the platform, after completing an initial online assessment, and prior to starting treatment. Clients provided informed consent to be contacted and to have their data stored, reviewed by mental health professionals, shared with relevant third parties (e.g., local health authorities in the case of established risk) if necessary, and deidentified and aggregated for research and quality assurance purposes.

Initial Assessment. Clients completed an initial online, non-diagnostic self-report assessment to determine their suitability for TAiCBT. The assessment included measures of symptom presence and severity, psychosocial stressors, physical health, and functioning. Completed assessments were reviewed by an intake specialist, a registered social worker, who conducted clarifying calls as necessary and otherwise assigned appropriate clients to a therapist, a registered social worker, psychotherapist, or psychologist. Clients were considered appropriate for treatment on the MindBeacon platform if they met the following eligibility criteria:

1. 16 years or older;
2. Residing in Canada;
3. Access to a computer and internet;
4. Able to read and write in English or French;
5. No active suicidality, self-harm, psychosis, no substance dependence, or uncontrolled mania;
6. Willing to provide an emergency contact.

Program Eligibility. Therapists reviewed their clients' assessments and used clients' scores on validated measures, their responses to open-ended questions (e.g., "What brings you here?"), as well as clinical judgment to determine which of the available MindBeacon programs – including programs for depression, generalized anxiety, chronic illness, chronic pain, alcohol use, health anxiety, panic, post-traumatic stress, insomnia, social anxiety, and stress management – would be most appropriate. Clients were assigned to the depression program if their score on the PHQ-9 (described below) was ≥ 5 (indicating at least mild symptom severity), if depression was determined to be their primary presenting problem and no other immediate need was identified, and if they expressed a desire to work on depression.

Primary Measure. The Patient Health Questionnaire (PHQ-9(Kroenke et al., 2001)) was used to measure the extent to which clients had experienced depressive symptoms over the previous two weeks, with nine items rated on a 4-point Likert scale from *0 Not at all* to *3 Nearly every day.* The PHQ-9 has been widely used and evaluated in primary care settings; it has sound psychometric properties, including high sensitivity, specificity, and reliability (El-Den et al., 2018). The measure is made available on the first day of treatment and every 7 days from its last completion.

Other Measures. The Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006) was also made available on the first day of treatment and every 7 days from its last completion. The Work and Social Adjustment Scale (WSAS; Mundt et al., 2002) was administered on the first day of treatment and every 28 days from last completion. The GAD-7 was used to assess comorbid anxiety and measured the extent to which clients had experienced symptoms of general anxiety over the previous week, with seven items rated on a 4-point Likert scale from *0 Not at all* to *3 Nearly every day.* The GAD-7 also has sound psychometric properties (e.g., Rutter & Brown, 2017). The WSAS was used to assess the impact of clients' presenting problems on their daily functioning and is not reported on in the current study.

Risk Management. Therapists were provided with guidelines for managing risk during treatment and were instructed to exercise clinical judgment and consult with peers and managers where appropriate. Suicide risk was primarily assessed by monitoring clients' scores on the PHQ-9, as well as by monitoring the messaging for client disclosures of risk. If clients scored ≥ 1 on the suicidal ideation item on the PHQ-9, indicating being troubled by suicidal ideation for several days over the previous two weeks, therapists would receive an alert from the platform. If therapists received this alert or any disclosures of suicidal ideation or intent from the client via messaging, they would follow up with further risk assessment and intervention if necessary.

Depending on their assessment of clients' level of risk, therapist interventions ranged from on-platform suicide safety planning to making appropriate referrals to other services or contacting emergency services in cases where the therapist had reason to believe the client posed an imminent risk to themselves or others.

Data Analysis. All client data, including initial assessments, treatment outcome measures, treatment material engagement, and therapist messaging, were captured via the MindBeacon platform and stored in a security and privacy compliant database. We extracted anonymized data from this database for all clients who had completed an assessment, consented to treatment and been discharged from treatment. Analyses were performed in parallel using both R and MATLAB.

In this study, the indicators of treatment success are achieving clinically reliable change on the primary outcome measure, the PHQ-9. A reliable change index is defined as part of IAPT to identify clients whose symptoms improvement exceeds what might be expected from measurement error or insignificant natural variation of each OM scale (IAPT Manual). A score change, from the first to the last OM, that met or exceeded that index is considered reliable clinical change (RCC). Clients on the depression protocol needed to have a decrease in score of 6 or greater on the PHQ to achieve RCC.

Repeated measure t-tests were used to explore the effectiveness of MindBeacon TAiCBT treatment for clients overall and for subgroups with different presenting symptoms. The four groups of interest were: (1) clients who had only depression symptoms that met caseness (DO), (2) clients who had both depression and anxiety symptoms that met caseness (DA), (3) clients who had only anxiety symptoms that meet caseness (AO), and (4) clients with mild symptoms who did not meet the caseness threshold for depression or anxiety (MS).

A logistic regression was used to explore the relative impact of moderating and mediating factors on clinically reliable symptom change (Wootton et al., 2021). We focused on those clients who had more severe symptoms at treatment onset (i.e., DO and DA groups) as those groups experienced similar levels of symptom change compared to the MS and AO groups where people did not reach caseness and fewer achieved RCC.

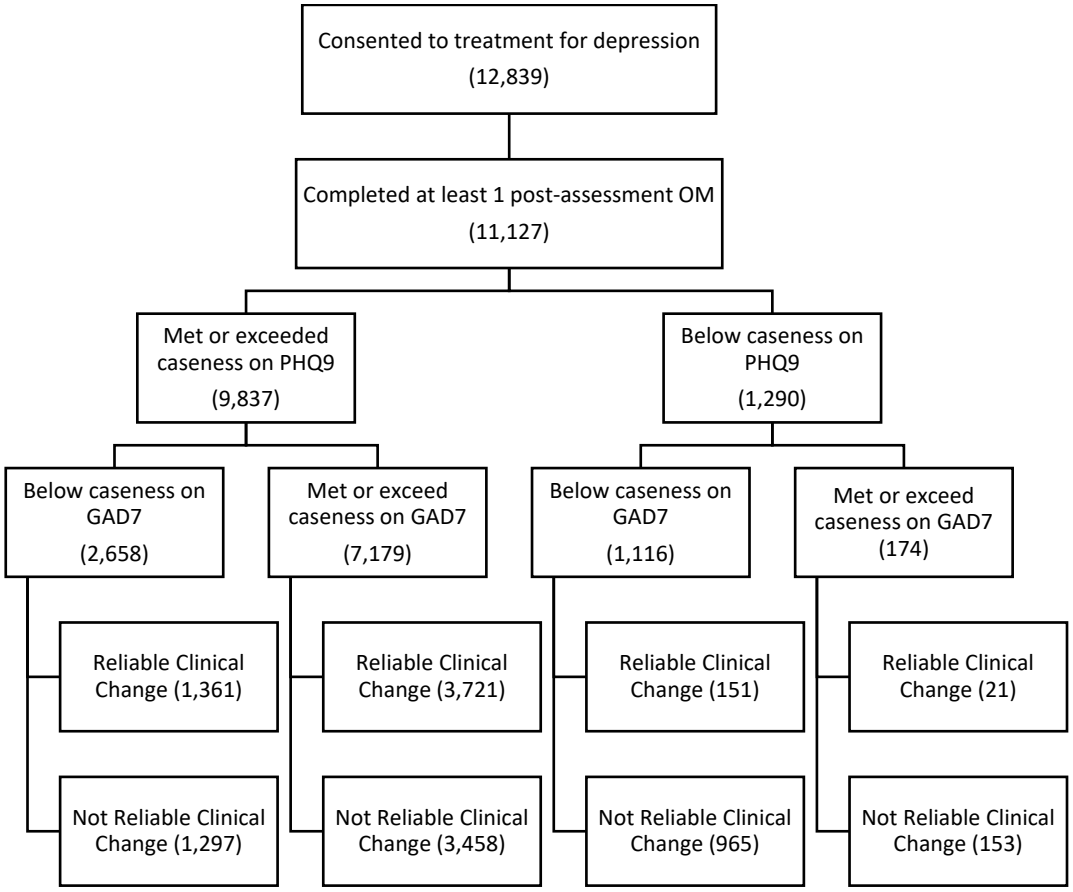
Data was split into training (80%) and test (20%) sets to create and compare 3 different regression models. The first model considers possible mediators of the treatment on symptom change, for example type of treatment materials, messaging interactions, symptom outcome measures, etc. The second model includes only moderators (i.e., client factors existing prior to treatment), specifically starting symptom severity. Because baseline symptom severity is known as a moderating factor on treatment outcomes, it provides a benchmark for model comparison, versus a model of only mediating factors. Finally, we combined the significant predictors from the first two models into a third combined model to determine the overall goodness of our model in terms of its ability to predict the binary classification of achieving reliable clinical change.

Forward stepwise regression was used to identify the mediators that best predict RCC. We included mediator variables that captured how clients engaged with treatment features over time as well as the amount and type of activities they completed. To measure timing, we included the number of distinct weeks in which clients were active as well as the number of distinct days they were active. We also broke these variables down further to explore the impact of spreading out different types of activities during treatment (e.g., distinct weeks that clients completed content, distinct weeks that clients messaged, distinct weeks that clients did symptom outcomes measures, and distinct days in which clients completed content or messaged).

To measure the activity amounts, we included the counts of total readings and worksheets completed, and the number of client messages sent. Finally, we included the number of therapists messages as a mediator to explore the impact of therapist nudges/feedback.

Results. In this retrospective study we examine program utilization and symptom change in the MindBeacon taiCBT depression protocol to determine the effectiveness of this treatment and to identify mediating and moderating factors of the intervention. As shown in Figure 1, 12,839 people consented to treatment during the time period of January 1, 2020 to December 31, 2021, 11,127 of whom had a least one post-assessment outcome measure score (OM). Of those 11,127 people, 9,837 had a pre-treatment PHQ9 score at or above the value for clinical caseness and also had at least one post-treatment PHQ9 score. 7,179 of these people also had pre-treatment GAD7 scores meeting or exceeding the value for caseness. Through treatment, 3,721 of these people experienced a reliable improvement in their depression symptoms.

Figure 1. Participant flow.



In our sample of clients who had at least one treatment OM, 88% scored above caseness (9,837) and the average PHQ9 score at assessment was 16, well above the threshold for caseness (Table 1). Clients who only suffer from depression (DO) had significantly lower PHQ9 assessment scores than those who suffer from comorbid anxiety (DA) ($U = 14{,}540{,}484$, $n_{DO} = 2{,}2658$, $n_{DA} = 7{,}179$, $p < 0.001$).

On average, clients were active for 6 weeks with 11 active days across those weeks. A client is considered active if they do one or more of the following actions on a particular day: complete a reading, complete a worksheet, submit an OM or message their therapist. The median number of readings completed was 28 and the average number of completed worksheets was 9. Clients successfully made use of therapist messaging, with an average of 12 messages sent from clients to their therapists and roughly twice that number being sent back to clients. Clients also check-in regularly to update their therapists on their symptoms. The average number of PHQ OMs completed was 4.

Table 1. Mean and standard deviation of treatment engagement and activity grouped by initial symptoms

	Mean (Std)
Initial PHQ score	16.02 (5.32)
Initial GAD score	10.35 (5.30)
Active weeks	5.74 (3.91)
Number of days active	11.47 (10.49)
Number of readings	27.92 (19.77)
Number of worksheets	8.70 (12.44)
Number of messages sent by clients	11.64 (20.84)
Number of messages sent by therapists	23.24 (19.46)
Number of PHQ OMs	4.16 (3.11)

The overall rate of achieving RCC in PHQ scores was 47.22%. The proportion of clients achieving RCC was higher in people who entered treatment with more severe symptoms (see Table 2). Clients whose scores met caseness criteria for depression only or caseness criteria for depression and anxiety achieved RCC 51.2% and 51.8% of the time.

Table 2. Depression symptom scores and change in symptoms grouped by initial symptoms

Group†	**N**	**Initial PHQ score**		**Final PHQ score**		**t-value**	**p-value**	**Cohen's d**	**% clients RCC**
		Mean	**SD**	**Mean**	**SD**				
All	11,127	16.01	5.31	10.52	6.19	101.12	<0.001	0.96	47.22%
DO	2,658	14.31	3.46	8.74	5.26	54.99	<0.001	1.07	51.20%
DA	7,179	18.28	4.22	12.07	6.18	89.51	<0.001	1.06	51.83%
MS	1,116	6.84	1.78	5.41	4.08	11.77	<0.001	0.35	13.53%
AO	174	7.59	1.32	6.18	4.00	4.69	<0.001	0.35	12.07%

†Definition for group abbreviations: All: the complete sample of clients with an initial and a final PHQ9 score; DO: clients in the sample who only have clinical depression symptoms (PHQ>=10 & GAD<8); DA: clients in the sample who have clinical symptoms for depression and anxiety (PHQ>=10 & GAD>=8); MS: clients in the sample who have mild symptoms for both depression and anxiety (PHQ<10 & GAD <8); AO: clients in the sample who have clinical symptoms of anxiety and mild symptoms of depression (PHQ<10 & GAD >=8).

Comparing initial PHQ9 scores to final ones for all clients shows an average change of 5.49 points, a significant difference ($t = 101.12$, $p < 0.001$). As seen in Table 2 the effect size (Cohen's d) of treatment on PHQ9 scores is 0.96 which is large and significant. There was a significant effect on PHQ9 scores in the DO and DA groups (Cohen's d: 1.07 & 1.06). Clients with low levels of depression and comorbid anxiety saw only modest improvements (Cohen's d: 0.35).

We performed multiple regression analyses to determine the relative impact of moderating and mediating factors on achieving RCC. A stepwise regression found that 5 of the 10 mediator variables were significant regressors on RCC. Those variables were used to train a logistic regression model with resampling. We used 10-fold cross validation and the parameters for the best fit model are listed in Table 3. All the variables except, the number of distinct weeks that clients completed content had significant coefficients.

We used the same procedure for the moderator model. A stepwise regression confirmed that both initial PHQ and initial GAD scores were significant regressors. Both were included in the logistic regression model and the best fit parameters are shown in Table 3. In the final combined model, we included only the variables that were significant in the mediator and moderator models. Once again, we trained the model with resampling and the best fit parameters are shown in Table 3.

Table 3. Best fit regressors and coefficients from three logistic regression models (n=7,870)

		Estimate	**Standard Error**	**p-value**
Mediator Model	(Intercept)	-0.700	0.046	$p < 0.001$
	Active weeks – OMs	0.096	0.026	$p < 0.001$
	Number of readings	0.010	0.002	$p < 0.001$
	Active days – all types	-0.027	0.006	$p < 0.001$
	Active weeks – all types	0.045	0.018	$p < 0.05$
	Active weeks – content	0.040	0.024	0.101 (ns)
Moderator Model	(Intercept)	-1.350	0.094	$p < 0.001$
	Initial PHQ score	0.109	0.007	$p < 0.001$
	Initial GAD score	-0.041	0.006	$p < 0.001$
Combined Model	(Intercept)	-2.451	0.112	$p < 0.001$
	Active weeks – OMs	0.140	0.023	$p < 0.001$
	Number of readings	0.012	0.002	$p < 0.001$
	Active days – all types	-0.028	0.006	$p < 0.001$
	Active weeks – all types	0.051	0.018	$p < 0.01$
	Initial PHQ score	0.123	0.007	$p < 0.001$
	Initial GAD score	-0.041	0.006	$p < 0.001$

Both the moderator-only and mediator-only models identify significant predictors of RCC, and when operationalized can predict outcomes better than chance. A model with only mediating factors can predict RCC 62.3% of the time, which is better than a model with only moderating factors (i.e., baseline symptom severity) at 58.8%. However, combining the mediating and moderating variables into a single model improves their predictive power (65%) and an information criterion analysis shows that this increase is still significant even when accounting for the added parameterization of the model (Table 4).

Table 4. Information criterion and accuracy statistics comparing model fit (n=1,967)

	AIC	**Accuracy**	**Sensitivity**	**Specificity**
Mediator Model	10444	62.32%	66.14%	58.76%
Moderator Model	10620	58.77%	54.68%	62.60%
Combined Model	10097	65.07%	63.62%	66.44%

The most significant variable in our regression analysis was the number of active weeks where clients completed an OM. In our best performing (combined) model, the odds of achieving RCC increase by 14% for each additional active week of OMs compared to 1% for each additional reading completed. This suggests that more than the total volume of treatment content, being actively engaged in treatment (with regular symptom check-ins) plays a much larger mediating influence on symptoms change from the intervention.

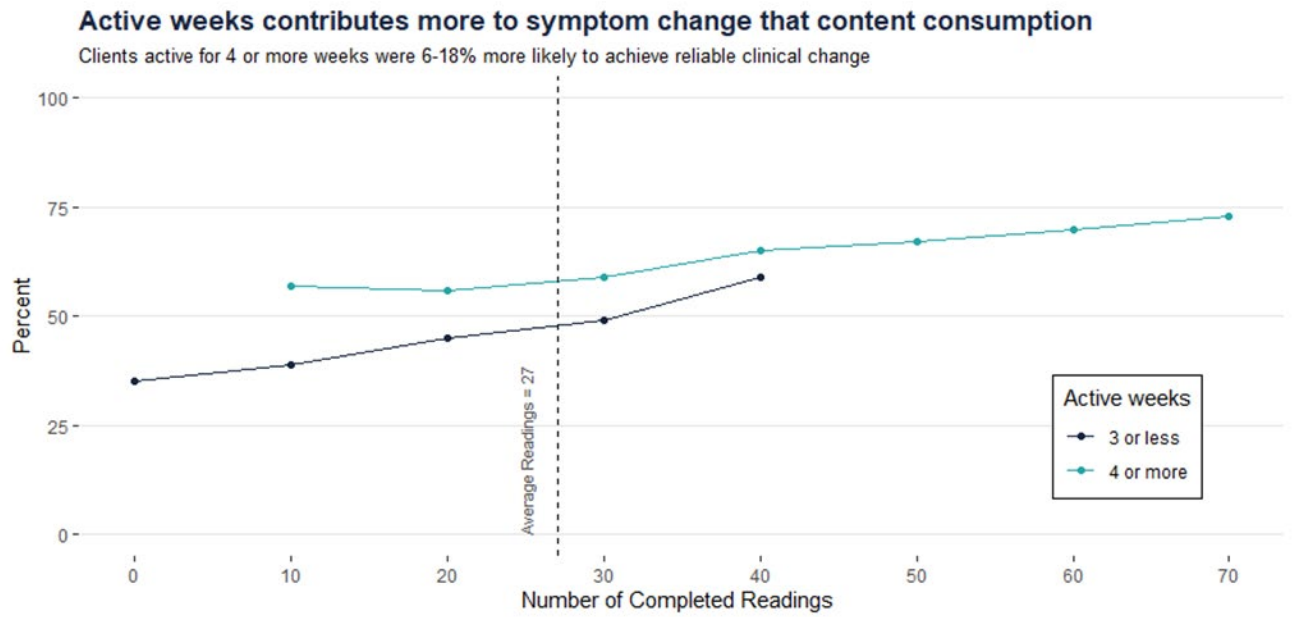


Figure 2. Proportion of clients achieving RCC grouped by number of readings completed and number of active weeks of treatment.

The percentage of clients who achieve RCC is much greater for those who have more active weeks, independently of the volume of readings completed (Figure 2). Clients who have four or more active weeks have 6-18% greater rates of achieving RCC over those with three or fewer active weeks with the same number of readings. Of clients who completed 30 readings (just above the median of 27), 59% of those with 4 or more active weeks achieve RCC, compared to 49% for those with 3 or fewer active weeks.

Discussion.

Between 2020 and 2021, MindBeacon rapidly increased their service capacity to meet the demand for mental health services in Canada. MindBeacon's TAiCBT treated thousands of people with clinically severe levels of depression, and thousands of people with clinically severe co-morbid anxiety. In fact, most of those treated had severe symptoms. 77% of clients started treatment with clinical level symptoms of depression; 56% suffered from clinical levels of both depression and anxiety symptoms.

In this study we analyzed data from all clients treated for depression with MindBeacon TAiCBT over a two-year period. Overall, 47% of clients experienced a reliable change in their depression symptoms by the end of treatment. MindBeacon TAiCBT is particularly effective at helping people with clinical levels of depression, with and without comorbid anxiety, recover. More than half of clients with clinically severe symptoms experienced reliable improvement.

During the period of analysis 1,290 people with mild symptoms were treated for depression. Fewer of these clients experienced a reliable change (12-14%) compared to those with more severe symptoms. This could reflect limitations of our primary outcome measure on capturing important changes. Clients with mild depression symptoms had starting PHQ9 scores between 5 and 9. The reliable change index for PHQ9 is 6, making some clients unable to achieve reliable clinical change. Future analyses should explore a wider range of outcomes (e.g., anxiety symptoms, functioning and satisfaction) to get a more holistic view of the impact of treatment for these clients.

The results of our logistic regression modelling are consistent with past research showing that increasing treatment engagement increases the number of clients achieving reliable clinical change. Symptom severity at the start of treatment, the amount of treatment content completed, and the frequency of engagement all contribute to symptom improvement.

One of the great benefits of TAiCBT is that it allows clients to set the pace and frequency of their therapy. What the current analysis adds to our understanding of the mechanisms of action in TAiCBT is that spreading engagement over multiple weeks is beneficial. For each additional week of active engagement clients were 14% more likely to achieve reliable change. Between 51% and 73% of clients who were active for 4 weeks or more saw reliable symptom improvement, even if they completed few readings. It is not surprising that greater levels of engagement with treatment materials is related to reducing symptom levels but given the fact that TAiCBT is designed to allow people to have choice around the pacing of engagement it is interesting to note that not all engagement patterns appear equally optimal. The learning and integration of treatment materials takes time, and our results are consistent with the idea that iCBT treatment implementations are likely to see better client outcomes if active engagement is drawn out, as opposed to condensed and intense.

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